Spring 2008

"I remember when I learned that": Gender differences in the use of episodic memory

Rhyannon H. Bemis
University of New Hampshire, Durham

"I REMEMBER WHEN I LEARNED THAT!": GENDER DIFFERENCES IN THE USE OF EPISODIC MEMORY

BY

RHYANNON H. BEMIS

B.A., Maryville College, 2004

THESIS

Submitted to the University of New Hampshire

in Partial Fulfillment of

The Requirements for the degree of

Master of Arts

in

Psychology

May, 2008

This thesis has been examined and approved.

Thesis Director, Michelle D. Leichtman,
Associate Professor of Psychology

David B. Pillemer,
Professor of Psychology

Brett M. Gibson,
Assistant Professor of Psychology

4 · 15 · 08

Date

ACKNOWLEDGEMENTS

I would like to thank all of the teachers, school principals, children and families who contributed to this research. I would also like to thank my committee members, David Pillemer and Brett Gibson, for their insights and helpful comments throughout the research process. Finally, I would like to thank my advisor, Michelle Leichtman, for taking a few ideas on notebook paper and turning them into an exciting research project; without her energy and patience the studies presented in this thesis would not have been possible.

The studies presented in this thesis were funded by a Summer TA fellowship awarded by the graduate school at the University of New Hampshire.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

"I REMEMBER WHEN I LEARNED THAT!": GENDER DIFFERENCES IN THE USE OF EPISODIC MEMORY

by

Rhyannon H. Bemis

University of New Hampshire, May, 2008

The experiments in this thesis were designed to investigate age and gender differences in the use of episodic memory. In experiment 1, children, ages 4 to 9 years, answered general knowledge questions and were asked how they knew the answer to these questions. Results indicated that there were some difference in the proportion of episodes girls reported. Girls' episodes also contained more details. Experiment 2 investigated source monitoring as a potential mechanism for children's use of an episodic recall style using a "drawer-task" with narratives as one of the source types. There were no gender differences, but there were age differences in children's ability to use narrative sources. Two pilot studies, conducted in a college and third grade classroom, confirmed the findings of experiments 1 and 2, indicating that there are age and gender differences in episodic memory, both in quantity and quality, that are apparent in the school years.

INTRODUCTION

Gender differences on standardized measures of math and science aptitude have received a great deal of attention from both educators and the public at large. There have been several hypotheses as to why these differences exist implicating, differences in problem solving ability, classroom behavior, and stereotyped expectations about math and science performance. An additional explanation is that the two genders have different ways of recalling target material. Whereas males may focus on recalling the knowledge itself (i.e. a semantic memory for the knowledge), females may focus on recalling the specific event in which the material was learned (i.e. an episodic memory of the learning event). If females are using a more episodic recall style, this could explain why they struggle on standardized measures of math and science, as these acontextual tests do not support an episodic recall style. The purpose of the present studies is to investigate the existence of an episodic recall style in females and to determine when in development evidence of this style emerges. Additionally, the present studies will investigate the role that one specific cognitive ability, source monitoring, plays in the development of an episodic recall style.

In the preceeding chapters, I discuss literature that is relevant to understanding gender and developmental differences in both episodic memory and source monitoring. Specifically, chapter one addresses the research on gender differences in math and science performance and chapters two and three address gender differences in episodic memory and the use of episodic memory in the classroom. Chapters four and five focus on episodic memory development and the emergence of source monitoring skills in children.

Pilot studies one and two and experiments one and two are presented in chapter six. These experiments were designed to test the existence of episodic recall in a variety of contexts and age groups. Further, source monitoring was specifically explored as a mechanism by which gender differences occur. The results of these studies are discussed in terms of gender differences in math and science performance in the general discussion section in chapter seven.

CHAPTER I

GENDER DIFFERENCES ON STANDARDIZED TESTS

In 2006, for the first time in the history of the SAT, females outperformed males on a section of the test, specifically the newly added writing section (Cloud, 2006). However, as in past years, female students' performance on the verbal and math sections of the test was lower than that of male students. Slight gender differences in performance on standardized measures of math and science are seen as early as third grade in some samples (Leahey & Guo, 2001). However, it is not until the high school years that there are significant differences in standardized test performance and this difference between genders is more apparent in samples of students who are considered "high achievers" (Leahey & Guo, 2001; Hyde, Fennema, & Lamon, 1990). This discrepancy in scores based on gender is perplexing especially considering that when measured by their actual classroom performance (i.e. grades) female students perform as well or better than male students in many subjects, including math and science (Castambis, 1995; Hyde, Fennema, & Lamon, 1990; Pomerantz, Altermatt, & Saxon, 2002).

The discrepancies in female students' performance can be explained by differences in socialization, choice of coursework, and cognitive strategies. Parents are more likely to encourage their daughters to master math concepts and are more likely to offer praise for effort, rather than performance (Kenney-Benson, Pomerantz, Ryan &

Patrick, 2006). In contrast, parents encourage their sons to simply outperform their peers rather than to truly master math concepts, and they are more likely to praise their son's performance rather than his effort (Kenney-Benson et al., 2006). In the classroom, this leads girls to put more effort into learning math concepts and to show less disruptive behavior, but in a standardized testing environment girls may interpret the differential encouragement they receive as an indication that they are not as good at math and thus they may underperform in response to this belief about their math ability (Kenney-Benson et al., 2006). Researchers have shown that even in adult women awareness of this socialized belief about their inferiority in math, termed *stereotype threat*, can lead to decreased performance in traditionally male domains, namely math and science (Ryan & Ryan, 2005; Steele & Ambady, 2006).

Perhaps due to stereotypical beliefs about their performance in math and science, females seek both coursework and careers in these fields less often than do males (Simpkins, Davis-Keane, & Eccles, 2006; Byrnes, Hong, & Xing, 1997). Since women do not engage in as many learning opportunities in math and science, they have less opportunity to develop the problem-solving skills that they need on standardized assessments, which could explain their performance (Byrnes et al., 1997). However, these explanations do not explain why high-achieving females, who complete as many math courses as their male peers, are still underperforming on standardized measures of aptitude in math and science.

An alternative explanation for why females and males differ in their performance on standardized measures is due to the cognitive strategies that each employ. Past research has shown that males are less likely to be distracted by incorrect answer choices and are more likely to quickly define an appropriate strategy to solve the problem (Byrnes et al., 1997). One reason for this difference in strategy may be the way in which women and men are recalling information. When women look at an exam question they may be attempting to recall the exact moment when they learned the material, thus they are relying on their episodic memory. In contrast, men may attempt to recall just the information relevant to the problem, thus they are relying on their semantic memory. Since standardized tests by their nature are more conducive to a semantic style of recall, the fact that women may be relying on a more episodic style could explain the differences in standardized test performance that are apparent in adolescence. Thus, differences in underlying cognitive strategy in combination with differences in motivation, early socialization, educational and career opportunities, and responses to perceived stereotypes, offer a more comprehensive explanation for why women are underperforming on standardized tests of math and science. Support for differences in cognitive strategy, with men relying more on a semantic strategy and women relying on an episodic strategy, can be seen in research describing gender differences in episodic memory as well as research on the use of episodic memory in the classroom. Additionally, there are two mechanisms, early parent-child memory conversations and source monitoring skills, that offer insight into why women develop a more episodic strategy that is manifested in their later math and science performance.

CHAPTER II

GENDER DIFFERENCES IN EPISODIC MEMORY

Laboratory tasks testing episodic memory

Women outperform men on traditional lab tasks testing episodic memory (Herlitz & Yonker, 2002; Lewin, Wolger, & Herlitz, 2001). However, a female advantage in episodic memory tasks is dependent on the type of processing involved. Lewin et al. (2001) found that while women performed significantly better than men on verbal tasks of episodic memory, such as those requiring them to identify a previously shown face or object from an array of distracter items or to retrace a previously taken route, they performed worse than men on visuospatial tasks of episodic memory, such as recalling which sides of a display of three-dimensional cubes were shaded in black. Interestingly, women's superiority on verbal episodic memory tasks was not related to their performance on measures of verbal ability, such as word fluency (Lewin et al., 2001). Herlitz and Yonker (2002) confirmed that performance on verbal episodic memory tasks was not related to a general superiority in verbal ability. The women in their sample performed similarly to men on both the verbal and full scale measures of the Wechsler Adult Intelligence Scale, but in spite of this similarity in intelligence women still outperformed men on measures of verbal episodic memory, including tasks in which they had to correctly identify previously presented target faces, abstract words, and concrete pictures from a list of distracter items (Herlitz & Yonker, 2002). The results of these two studies indicate that while verbal ability alone cannot explain the differences between men and women on tasks of episodic memory, on tasks that allow for verbal processing of information (i.e. repeating to oneself names of familiar objects or faces) women take advantage of this mode of processing and thus outperform men (Herlitz & Yonker, 2002; Lewin et al., 2001).

Women also outperform men on social problem solving tasks that involve episodic memory. Goddard, Dritschel, and Burton (1998) found that when men and women were asked to provide a specific episodic memory in response to verbal cues, women gave more detailed responses, especially regarding negative episodes. Also, women were more likely to use specific detailed episodes to solve hypothetical social problems than men, who were more likely to provide a more generalized solution to the problem (Goddard et al., 1998). The differences between men and women became especially apparent when they were asked to complete distracter tasks in addition to the episodic memory and social problem solving tasks. Whereas women's performance was significantly reduced, men's performance was not affected by the addition of the distracter task because they had provided so few detailed episodes and solutions during the baseline task (Goddard et al., 1998).

These differences in performance between men and women on episodic memory tasks are also seen in young adolescents. Boman (2004) found that 13- and 14-year-old females outperformed age-matched males on two episodic memory tasks, a face recognition task and a cued text recall task. Furthermore, using self-report measures of attention, motivation, and overall affect while completing the task, Boman (2004) found that none of these factors could explain the differences in performance on the episodic memory task. Thus, unlike previous explanations on differences in classroom performance (Kenney-Benson et al., 2006), the female students did not report being less distracted, more motivated, or having more positive attitudes toward completing the task, indicating that their superior performance can be attributed to a more episodic processing strategy.

Naturalistic Tasks of Episodic Memory

Gender differences in episodic memory are also apparent in more natural contexts in which participants are asked to give detailed narrative about their own personal past. When older women were interviewed about a range of topics including health, ageing, children, and work, they provided more specific event episodes than did men, especially for topics involving children/grandchildren, marriage, and ageing (Pillemer, Wink, DiDonato, & Sanborn, 2003). However, the length of women's narratives on any of these topics was not significantly longer than men's, indicating that women were not simply talking more but that the content of their reflections was qualitatively different than men's (Pillemer et al., 2003). Also, women were more likely to indicate that they used the contents of their specific episodic memories to solve problems, teach future generations, and manage relationships (Pillemer et al., 2003). The function of women's memories to manage relationships was also supported by Ross & Holmberg (1992) who found that women were more likely than their husbands to provide vivid, detailed narratives of shared events including a first-date, a vacation, and an argument. The women in this sample also reported that the memories were more important to them and they thought about them more often than their husbands did (Ross & Holmberg, 1992). The results of both of these studies indicate that for women recalling past events is a practical way of managing current life situations, including relationships (Pillemer, 1998).

Evidence of this tendency in women to recall more detailed past events that are socially directed is seen early in development in young girls (Buckner & Fivush, 1998; Fivush & Buckner, 2003). Buckner and Fivush (1998) asked 9-and-a-half-year-old boys and girls to describe nine different events that were related to some aspect of their character. For example, to assess children's sense of achievement they were asked to describe a time when they worked really hard on something (Buckner & Fivush, 1998, p. 413). The narratives that girls provided to these prompts were not only more detailed than those of boys', but they also contained more references to other people and the specific roles that these people had in their lives (Buckner & Fivush, 1998). Interestingly, on a separate measure of the child's sense of self, the Children's Self-View Questionnaire, boys and girls did not differ in the way in which they defined themselves; thus, it was not the case that girls defined themselves as being more socially affiliated so that elf-concept later appeared in their narratives (Buckner & Fivush, 1998). Rather, both boys and girls rated themselves as equally social, but only girls used the narrative format to express their social sense of self.

Gender differences in the expression of episodic memories are also seen in the natural social conversations of boys and girls. Leichtman, Pillemer, Liu, and Embree (2008) asked male and female adolescents, between the ages of 12.4 and 14.6 years, to record their natural conversations with parents and peers for a two-and-a-half hour block of time. During this time, adolescent girls were more likely to engage in talk about specific memories as measured by the number of specific memories girls reported as well as the amount of time that girls spent talking about memories. This indicates that even outside of the more sterile lab environment, girls are spontaneously choosing a more narrative style of communication.

CHAPTER III

EPISODIC MEMORY IN THE CLASSROOM

The college classroom

While men and women perform differently on episodic memory tasks both in the lab and in more natural environments, both genders can benefit from recalling particular classroom episodes. Conway, Gardiner, Perfect, Anderson, and Cohen (1997) asked college students enrolled in either a traditional lecture course in psychology (i.e. introductory psychology, social psychology, developmental psychology) or a research methods course to indicate how they determined the answer to multiple-choice exam questions. Specifically, students were asked to indicate whether they remembered the exact moment when they learned the answer, they just knew the answer, they felt that one of the answer choices looked more familiar, or they simply guessed the answer. In the lecture-based course, more students reported remembering specific classroom episodes that led them to their answer and this strategy was positively correlated with performance on the exam. However, when this group of students was given a cumulative exam at the end of the academic year, they were more likely to report that they just knew the correct answers. This shift from remembering the moment when they learned the information to simply knowing the information indicates that the students had formed a more general knowledge base of the course material that was not based solely on recalling the context in which they learned it (Conway et al., 1997). This type of general knowledge, which is equated with semantic memory, allows for more efficient recall. This is particularly true on cumulative exams and standardized aptitude tests.

In contrast to the shift in memory strategy seen in the lecture-based courses, students in the research methods course reported using a more semantic recall style both on their initial exams and on the cumulative final (Conway et al., 1997). The dominance of semantic recall in this particular course may be due to the fact that the material presented in this course emphasized learning procedures and designs which are more congruent with semantic processing than the lecture course, which presented a variety of topics from multiple areas and emphasized a more conceptual understanding (Conway et al., 1997).

While the transition from episodic to semantic recall occurs at a faster rate in more concentrated areas that ask students to focus on learning methods and procedures, such as many math and science courses, student of both genders can benefit from a more episodic teaching style in these courses. Herbert & Burt (2004) presented 39 undergraduate students enrolled in an introductory statistics course with written lessons on the difference between repeated measures and independent measures t-tests. The lessons were matched in terms of length and complexity, but differed in the amount of narrative example (i.e. episodic material) that they provided. Students in each group were given 40 minutes to review the written material and they were tested on this material in two separate testing session. One of the sessions took place two days later and the other five-weeks later. Each test contained multiple choice and short answer questions and following each question students were asked to indicate how they had learned the material presented in the question using the same options that were used by Conway et al. (1997).

Students given the more episodic instructional material outperformed students given less episodic instructional material on the short answer section during the first testing session and on both the multiple choice and short answer sections during the second testing session (Herbert & Burt, 2004). In the first session, students in the episodic condition reported remembering the moment when they learned the information more than did students in the less episodic condition. However, by the second testing session students in the episodic condition were reporting more know responses than those in the less episodic condition, indicating that students who were presented with more episodic material initially were more likely to use these episodes in their immediate recall, but in their delayed recall students were able to use the initial episodes to create a knowledge base of the material that supported a more semantic processing style. Similar to the findings of Conway et al. (1997) in the first testing session, the proportion of remember responses was positively correlated with students' performance, but after a five-week delay, it was the proportion of know responses that was correlated with performance. Thus, even with a relatively short delay of five weeks, the episodic teaching style enhanced students' long-term recall of the material.

The elementary and middle school classrooms

Observational studies of elementary and middle-school aged children indicate that they also use specific classroom episodes to recall material on in-class tests (Nuthall, 1999; Nuthall & Alton-Lee, 1990; Nuthall & Alton-Lee, 1995). These observational studies typically focus on the behavior of five students throughout an entire academic unit, such as a unit on Antarctica or weather. At the end of each unit, children are given tests, both two to three weeks following the unit and 12 months following the unit to measure the amount and type of information that they have learned (Nuthall, 1999; Nuthall & Alton-Lee, 1990; Nuthall & Alton-Lee, 1995). Furthermore, children are interviewed at each of these time periods to discern how they answered each question and which classroom episodes were particularly salient for them. This approach allows for a particularly rich analysis of how children use particular classroom episodes and of individual differences in the way children use and recall classroom material.

Interviews with each child indicated that, just as with college students, children who reported remembering a particular classroom episode when they learned the material were more likely to recall the material (Nuthall, 1999; Nuthall & Alton-Lee, 1995). For example, during the unit on Antarctica, one of the students reported knowing that there are volcanoes on Antarctica because he remembered seeing a picture in class of man standing near an active volcano (Nuthall, 1999, p.325). Students also used their own thoughts during a classroom episode to help them arrive at the answer in both the immediate and delayed test (Nuthall, 1999). During the unit on weather, one student reported recalling that a thermometer contains mercury because she remembered the time that her classmate said this and she thought he must be wrong until the teacher confirmed the answer (Nuthall & Alton-Lee, 1995, p.195). Furthermore, during the test occurring 12-months after the unit students who reported three such episodes during the more immediate recall test were more likely to have recalled the material, but students who had not had three such meaningful episodes were less likely to recall either the specific material or the episode in which it was learned (Nuthall, 1999; Nuthall & Alton-Lee, 1995).

Recall of particular learning episodes also helped children to infer material that was not explicitly presented to them (Nuthall, 1999). This is due to the fact that children who were able to recall a particular episode in detail were more likely to be able to use these details to infer the correct answer. For example when asked about the dangers of fire in Antarctica students who were able to report in detail the story that a guest speaker told them about how hard it was to obtain water and how dry the climate was were more likely to correctly infer that fire was a particular danger of life in Antarctica (Nuthall, 1999).

While the observational studies of the use of episodic memory in the classroom have consistently indicated that children recall different classroom episodes and experiences to help them remember specific classroom material, none of these studies have looked more broadly at gender differences. It is likely that because women show a particular advantage in recalling episodic memories, they may be more likely than males to use episodic memory in a classroom context. Leichtman, Pillemer, Comley, Vigliatura, and Skowronek (2007) investigated whether middle school males and females would differ in the proportion of specific episodes that they recalled during a classroom exam. In this study eighth-graders were asked to indicate how they answered exam questions from four different courses, math, science, social studies, and language arts. Students were asked to indicate whether they remember the moment when they learned the information, they just knew the answer, they guessed the answer, or they used some other problem-solving strategy. Female students reported using more episodic memories in math and science courses and the use of episodic memory in both of these courses was positively related to exam performance. Thus, students who used episodic memory to recall course information were likely to perform better on the exam than students who did not use this strategy. These results indicate that an episodic strategy is beneficial to both genders but may be especially advantageous for females.

While there are biological mechanisms that may explain females' advantage in episodic memory tasks (Cahill & van Stegeren, 2003), two additional mechanisms, early parent-child conversations and source monitoring skills, offer insight into why using an episodic strategy is particularly beneficial for females. These mechanisms explain why men and women may come to adopt different cognitive strategies that are later manifested in their performance in all domains, but especially math and science.

CHAPTER IV

PARENT-CHILD MEMORY CONVERSATIONS

Between the ages of 3 and 4 years, children develop the ability to spontaneously and independently report a past event (Pillemer, 1998; Bauer, 2007). In a seminal study Hamond and Fivush (1991) found that children who were 37 months of age during a family trip to Disneyworld were able to provide accurate narratives both 6 and 18 months after the trip. However, their narratives were not as detailed as those of children who were 49 months-old at the time of the trip. Further, the younger children needed more interviewer prompts to accurately report the details of the trip (Hamond & Fivush, 1991). This indicates that while children between the ages of 3 and 4 years are able to verbally recall past personal events, they are more reliant on adults to facilitate this recall through direct questions and prompts than are older children. The main support for the scaffolding necessary in promoting children's episodic memory development is the research on parent-child memory conversations in shaping children's recall of the past.

Before children are able to give spontaneous reports about past experiences, parents engage their children in conversations about the past (Fivush & Fromhoff, 1988; Pillemer, 1998). However, while all parents engage in some kind of memory conversations with their child, there are differences in the styles that parents use in these conversations. Fivush and Fromhoff (1988) recorded the conversations of ten 2.5 years-olds and their mothers and found two different types of conversational styles, elaborative and repetitive. Elaborative mothers provided additional information about the events being described, offered specific evaluations of the event, and persisted in keeping conversation about the event going even when their child seemed not to recall any information. In contrast, repetitive mothers tended to repeat the same question without providing new information, offered few evaluations of the event, and were more likely to stop the conversation or change the topic if the child was not recalling information (Fivush & Fromhoff, 1988). Children of elaborative mothers tended to recall more information about the event being discussed than did children of repetitive mothers. These differences in recall may due to the fact that children of more elaborative mothers are given more details of the event that serve as cues to recall whereas children of repetitive parents are not given such details (Fivush & Fromhoff, 1988). Also, by using these different conversational styles mothers are communicating different goals of reminiscing to their children, which may in turn affect their willingness to report information that they recall. Since elaborative parents encourage their children to continue in the social aspects of the memory conversation even when they cannot remember a particular piece of information, these children have more opportunities to report new information about the event that may not have been solicited by their parent. In contrast, repetitive parents encourage their children to report a single piece of correct information and abruptly end the conversation when this information is not provided, thus their children are implicitly discouraged from providing unsolicited details, even if they recall them.

In Fivush and Fromhoff's (1988) sample of 2.5-year-olds, the structure that parents' provided in their memory conversations was necessary for the child to provide any information about the past, as children are unable to provide un-scaffolded narratives at this stage of development. However, as children age they are increasingly able to provide coherent narratives of past events. It is possible that as children become more proficient in talking about the past, parents change their conversational style. In a longitudinal study investigating parent-child conversations for specific shared events when children were 40 months-old and ending when they were 70 months old, Reese, Haden, and Fivush (1993) found that with time all parents became more elaborative. However, parents who were more elaborative at the beginning of the study remained so throughout the study and the same was true of repetitive parents; thus parents stayed within their general conversational style. As was seen in Fivush and Fromhoff's (1988) study children whose parents were more elaborative recalled more information during the first conversations as well as subsequent conversations (Reese et al., 1993). When children of elaborative mother reached 58 months of age the amount of additional information that they provided influenced the amount of memory elaboration their mothers provided in the recorded conversation that followed when the children were 70 months of age (Reese et al., 1993). This indicates that initially parents are responsible for their children's memory responses, but as the children become more proficient at recalling information, the amount of information they provide influences the amount of information their parents provide in response.

While all children move from providing minimal information that is heavily dependent on their mother's probes, to providing their own information and actually influencing their mother's responses, there are gender differences in the amount of details and elaborations that parents and children provide (Reese et al., 1993). Across all time points, mothers used a more elaborative style with their daughters than with their sons. This gender difference in conversational style was not readily apparent in the children's own productions until the age of 58 and 70 months, when girls provided more additional memory information than boys. However, both genders were matched on the amount of non-memory statements, indicating that girls were not simply saying more (Reese et al., 1993).

Since all of the parents in the previous study were mothers, it was impossible to determine the degree to which gender of the parent influenced the gender differences seen in children's memory statements. Since in everyday conversations, fathers tend to be more repetitive and place more demands on the child's language skills, it was hypothesized that in conversations specifically about past events, fathers would be more likely than mothers to adopt a more repetitive style (Reese & Fivush, 1993). Using the same interview procedure as Reese et al. (1993), Reese and Fivush (1993) recorded memory conversations of 40-month-old children individually with their mothers and fathers. In contrast to study predictions, there were no differences based on gender of the parent, with both fathers and mothers equally likely to use either of the two styles. However, there were style differences based on the gender of the child, with parents of daughters being more elaborative overall than parents of sons. However, there were no gender differences in the use of repetitive style, thus parents were not being more repetitive with sons, they were just not using the same degree of elaboration that was seen in parents with daughters (Reese & Fivush, 1993). Similar to the findings of Reese et al. (1993) children of more elaborative parents recalled more information, with girls recalling more than boys (Reese & Fivush, 1993).

These gender differences in conversational style impact not only the amount of information that children recall about the shared events being discussed, but also the recall of unshared events that the child experiences without the parents. Leichtman, Pillemer, Wang, Koreishi, and Han (2000) recorded mother's conversations with their four- and five-year-old children following a surprise visit at school by their preschool teacher and her new baby, an event for which their mothers were not present. The children were given a special object to hold and watched the director of their preschool give the teacher some balloons and a gift for the baby. Mothers were asked to speak naturally with their children after school on the day that the event occurred. Three-weeks following their conversations with their mothers, an interviewer, who was also not present at the event, asked each child about the event, using a standard set of open-ended and direct questions. Children whose mothers were more elaborative were able to report more correct details both in their conversation with their mothers and in their interviews three weeks later (Leichtman, Pillemer, et al., 2000). Interestingly, children whose mothers were more repetitive actually recalled fewer details when interviewed three weeks later. Thus, even when mothers have no knowledge of the event, their use of elaborations increases the likelihood that their child will correctly recall the details of an event (Leichtman, Pillemer, et al., 2000). As can be seen in the fact that repetitions were not related to correct recall, the success of the elaborative style in enhancing later recall cannot be attributed to the simple rehearsal of salient events.

Rather than simple rehearsal, the social-cultural model of the development of autobiographical memory (Fivush & Nelson, 2006; Nelson & Fivush, 2004) posits that parent-child memory conversations actually serve to model for the child how to search his or her memory for relevant details. Thus, by providing more details, more elaborative mothers are giving their children additional cues that can be used when searching for a particular event or piece of information and are illustrating how to use those cues effectively (Fivush & Fromhoff, 1988; Fivush & Nelson, 2006; Nelson & Fivush, 2004). This instructional feature of early parent-child memory conversations can be seen in the fact that as children age they do not simply repeat facts about an event that they have heard from their parents, but they offer new information and begin to initiate conversations about new shared and unshared events (Hudson, 1990; McCabe & Peterson, 1991).

Since girls are receiving more elaborative information from both parents early on in their memory development, it is likely that they become more proficient and familiar with using the details of an event (i.e. the time, place, and context) to recall important sources of information learned in that event. Therefore, for females the episode in which something was learned becomes an important source of information in and of itself. The ability to recall the source of a given piece of information, called source monitoring, develops between the ages of three and eight. While none of the research on source monitoring has focused on gender differences, it is possible that since parents model for their girls, and thus indirectly instruct them, to search their memories for cues related to the event that helped them to learn a given fact, girls may show differences in source monitoring ability. This could explain why women outperform men on tasks of episodic memory and why they report using a more episodic style of recall in the classroom.

CHAPTER V

SOURCE MONITORING

Source monitoring theory posits that necessary details of the source of a piece of information are not encoded when a learning event occurs (Johnson, Hashtroudi, & Lindsay, 1993). Rather, the source details of the event are actively inferred later during recall when the individual reflects on both the quality and contextual details in the memory to derive its source. For example, in order for a student to recall that he or she learned a fact in the classroom, that student would have to recall the fact that the event occurred during school hours, that it was written on the blackboard, and that the teacher had a classmate read the information out loud. All of these particular features of the learning episode when reflected upon later would lead the student to conclude that the fact had to be learned in the classroom. Therefore, according to the source monitoring theory the ability to accurately recall the source of a piece of information involves a decision making process using different details of the event, rather than retrieval of a previously encoded source per se (Johnson et al., 1993).

According to source monitoring theory, young children have an especially difficult time recalling the source of information because they fail to attribute the details they recall to the correct source (Johnson et al., 1993; Roberts, 2002). This implies that, while children may recall details of an event accurately, they fail to engage in the reflective decision-making process to infer the source of the learned information. Young children's source monitoring ability has been tested using both different sources, including specific cues, verbal suggestions, and visualization, and different to-be-recalled information, including memory for locations, actions, novel facts, and particular episodes.

Gopnik and Graf (1988) measured children's memory of the source of information for the location of hidden objects. In this task, children, ages three, four, and five years, saw a 3 x 2 set of six drawers and were asked to remember the contents of each drawer. They learned the contents of each drawer either by seeing it, being told what it was, or inferring it from a clue. Children were asked to identify where the object was located and how they knew this information both immediately following training in the immediate recall task and following the immediate recall task in the delayed recall task. At both the immediate and delayed recall tasks, children of all ages were able to correctly recall where the items were located, however, there were significant ages differences in memory for the source of information. Three year-olds remembered fewer of the six sources (M= 3.96) than four-year-olds (M= 5.12) and five-year-olds and (M=5.66), respectively. Furthermore, three-year-olds' memory for sources was reduced in the delayed task in that approximately half of the three-year-olds who remembered a source correctly in the immediate recall task failed to do so in delayed recall, even though the delayed task directly followed the immediate task. This effect was not seen in the older age groups, indicating that the ability to discriminate between external sources of information undergoes major developmental changes between the ages of three and five years (Gopnik & Graf, 1988).

Leichtman, Morse, Dixon, and Spiegel (2000) administered a similar version of Gopnik and Graf's (1988) drawer task to a sample of three- to five-year-olds. They also found that children were highly accurate at recalling the location of the object, but the children in their sample performed much below those of Gopnik and Graf (1988) with only 42% of children answering half of the source monitoring questions compared to Gopnik and Graf's study where the mean percentage of correct responses was well above half (66%). The reason for this difference is not differing degrees of difficulty in the task. In fact, even when Leichtman, Morse, et al. (2000) gave the children clarified instructions about the task, they still performed significantly worse than Gopnik and Graf's (1988) sample. One reason that Leichtman, Morse, et al. (2000) cite for this difference in performance are the characteristics of each sample. Gopnik and Graf's sample reflected a higher SES than did the sample used by Leichtman, Morse, et al. (2000) which contained a broader range of economic backgrounds.

Taylor, Esbensen, and Bennett (1994) found that children between the ages of four and five years have difficulty stating when they have learned a novel fact. In a series of four studies, Taylor et al. (1994) taught children a series of novel facts about animals, basic chemistry, and novel color names. When taught about novel animal facts (i.e. tigers' stripes go up and down for camouflage) in the context of a story both 4- and 5-year-olds were likely to report that they had known the fact for a long time, even though they had just learned it moments earlier. Even when experimenters conducted a pretest to ensure that children did not know the novel facts that were to be presented in basic chemistry experiments (Experiment 2), both four-and five-year-olds reported that they had known the fact for an extended period of time and most responded "yes" when asked directly if they had know the fact when they were 3-years-olds. Taylor et al. (1994) posited that children's difficulty in discriminating between novel and familiar facts may be that they knew part of the fact (i.e that tigers have stripes) but did not know the other part of the fact (i.e. that they are for camouflage). Thus, in a follow-up experiment (experiment 3) children were taught more narrowly construed facts, color names. In this condition, five-year-olds were accurate in stating that they had just learned the new color, but four-year-olds were still likely to report that they had always known it, just as in experiments 1 and 2. However, in an extension of the color instruction paradigm (experiment 4), when children were explicitly told that they would be taught the name of the unfamiliar color, both four- and five-year-olds accurately reported that they had just learned the novel color. Therefore, with salient cues about the source of the information, such as being informed that they are about to learn something new, younger children can indicate the moment when they learned the information (Taylor et al., 1994).

Four-year-olds reliance on more explicit cues in the paradigm by Taylor et al. (1994) may be because younger children have difficulty separating internally created cues (i.e., their own thoughts about learning material) from an actual external learning event. This may lead children to be unable to differentiate their own states of knowledge before and after an event. To discern children's ability to discriminate between external and internal sources, Foley and Johnson (1985) asked groups of six- and nine-year-olds as well as a groups of adults to either watch two people performing a set of actions (the watch-watch condition), to perform on action themselves and then watch another person perform an action (the do-watch condition), or to perform one action themselves and then pretend to perform the other action themselves (the do-pretend condition). While six- and nine-year-olds in the watch-watch and the do-watch condition performed similarly to adults in identifying the source of a given action, the children in the do-pretend condition performed significantly worse than adults in defining the source of an action. Specifically, the children had difficulty determining whether they had actually performed the action or just imagined doing it (Foley & Johnson, 1985). This indicates that when both sources of information are internal (i.e. produced by the individual) then children have more difficulty differentiating between sources than when both sources are external (the watch-watch condition) or one source is external and the other is internal (the do-watch condition). Therefore, like the development of many other skills, the development of source monitoring skills develops in stages with self versus other distinctions occurring first, other versus other distinctions occurring next, and self versus self distinctions occurring last (Foley & Johnson, 1985; Roberts, 2002).

Children's inability to master source monitoring for two internal sources, even when they can make the discrimination between two external sources and between internal and external sources, can explain why children can be lead to create false memories of an event. Ceci, Crotteau-Huffman, Smith and Loftus (1994) interviewed children in two age groups, three to four years and five to six years, about two true events and two false events. Children were interviewed seven to ten times and each time they were asked to indicate whether the event had happened to them. The final session was conducted by a new interviewer who asked the children to indicate whether the event had happened and to provide details about those events that they agreed had happened to them. In the initial interview sessions, children in the younger group were more likely to assent to false events, but by the final session there were no differences between the two age groups, with 36% of the three-and four-year-olds and 32% of the five-and-six-year-olds assenting to false events. Children's increasing assent to false events across interviews indicates that when given repeated cues about a false event even older children have difficulty discriminating between the ideas presented by the interviewer and their own memory for events and therefore they come to attribute the interviewer's suggestions as being a true event (Ceci, Crotteau-Huffman, et al., 1994).

In an extension of this study, Ceci, Loftus, Leichtman, and Bruck (1994) asked children to visualize events that they reported did not happen to them. In this study, children were interviewed 12 times and at the final session a new interviewer told the children that the former interviewer had made several mistakes, including asking the child about events that did not happen. Even with the knowledge that the previous interviewer could have mistakenly interviewed them about false events, children in both age groups falsely assented to more events than did children in the previous study by Ceci, Crotteau-Huffman et al (1994), 42% and 38%, respectively. Therefore, when children are given external sources of misinformation from an interviewer and asked to generate their own internal sources of misinformation, it becomes increasingly difficult for them to determine the source of the information and in turn to recall the event correctly (Ceci, Loftus et al., 1994).

Bright-Paul, Jarrold, and Wright (2005) hypothesized that one reason why preschoolers may have difficulty identifying the source of their knowledge in the aforementioned paradigms is that they may not understand the source options. To control for this difficulty, Bright-Paul et al. (2005) presented one group of children, ages three to four years and six to seven years, with visual reminders of the sources of information about an event that was presented to children initially as a film and then as a misleading story. The visual reminders were three mailboxes labeled with pictures indicating that the action occurred in the film, the story, or in both formats. Children in this condition were asked to put a card with the story action on it in the appropriate mailbox whereas children in the other condition were asked to confirm or deny that a particular action occurred in an individual source (i.e. did Sara eat a sandwich in the story?) (Bright-Paul et al., 2005, p.8). While children in the younger group labeled fewer sources correctly than children in the older age group, children in the visual cue condition outperformed children in the question condition regardless of age. However, the authors note that the beneficial aspect of the visual format may not be in the presence of visual cues, but in the fact that children in this condition were presented with all possible source options at the same time whereas children in the question format were only asked about one source at a time (Bright-Paul et al., 2005). This difference in formats is significant considering that Bright-Paul et al. (2005) found that the younger children in their sample showed a considerable tendency to say 'yes' to any of the source confirmation questions, which could have impeded their correct reports.

Even with appropriate visual and verbal cues about the type of source, younger children still make significantly more source errors than older children (Bright-Paul et al., 2005). Due to this discrepancy in performance, several researchers have attempted to implement source monitoring training programs with young children with mixed results. Thierry, Spence, and Memon (2001) used a technique in which they asked children, ages three to four years and five to six years, to recall a set of actions that occurred in a filmed and live version of a science demonstration. In the training activity, children were asked to either identify the source of the action using a forced-choice format or they were asked to confirm, using a yes-no response, that the action had occurred. Thierry et al. (2001) found that when three- and four-year-olds who had received the source questions in training were interviewed later with misleading questions, they were as likely to recall the source of the information and resist suggestive influences as children in the older age group. Thierry, Goh Pipe, and Murray (2004) replicated these findings with seven- and eight-year-old children showing that in some conditions children can be taught to recall the source of information.

While Thierry et al. (2001) found that young children can benefit from source monitoring training, other researchers who have used different training methods have not found these same benefits. Leichtman, Morse, et al. (2000; experiment 3) presented groups of three- and five-year-olds with three stories that were told through a book, a film, or action figures. In one condition children were trained prior to the interview by reviewing target details of the story and the source of this information (i.e. "in the video we saw Toad and his friend drinking tea" p.271). When three-year-olds were interviewed later after receiving misinformation about all of the stories they were less accurate than five-year-olds regardless of whether they had received source monitoring training. In contrast, five-year-olds who had received source monitoring training were more accurate than children who received no training, but they were not more accurate than children who had received memory training without specific mention of the source (Leichtman, Morse, et al., 2000). Therefore, for older children simply reminding them of the target details may be enough to increase their memory for the corresponding source. This can be seen in the fact that when three-year-olds correctly recalled the action they were near chance at recalling its source (39%) whereas when five-year-olds correctly recalled the action the vast majority of the time they also recalled the source (68%).

Using a misinformation paradigm very similar to Thierry et al. (2001) in which children saw and then were read to about science demonstrations, Poole and Lindsay (2002) found that children under the age of seven failed to benefit from source monitoring training and provided just as many false memories as did children who received no such training. One reason for the differences in ages at which source monitoring training has been found to be effective could be that each of the aforementioned studies used different training procedures. Thierry et al. (2001) and Thierry et al. (2004) used a quiz-like training procedure in which children were given objective questions about the source of each action and then were given corrective feedback. This procedure is effective in having children memorize the correct answer about a given source in the limited context of the study and may explain why even young children in these studies performed as well as older children. In contrast, Leichtman, Morse, et al. (2000) and Poole and Lindsay (2002) used more natural instructional formats in which children were reminded through verbal statements about the sources of the material and of the distinction between different sources. This more instructional approach may be beneficial in modeling for children the process of searching their own memories for relevant source cues, but because younger children do not possess the requisite cognitive skills to carry out and comprehend such a search, this training strategy is not effective for them.

The ability to use effective search strategies may be a particularly important skill for school age children because in a classroom environment they encounter information from multiple sources and need to be able to recall that information on various classroom assignments and tests. Since Leichtman, Morse, et al. (2000) and Poole and Lindsay

(2002) have found that children five years of age and older naturally connect a fact with the source of that fact, then enabling children to recall sources effectively may benefit their overall recall for academic material. One strategy for improving recall is to provide more source cues for children. Pearse, Powell, and Thompson (2003) found that children ages six and seven years who experienced a series of four events and then were asked to recall only the last event, recalled more specific information about this event if they were given distinct contextual cues, such as a different badge to wear, during the event. This is due to the fact that the children used these cues to help them recall both the time and location of specific events that had occurred which in turn helped them to recall target facts associated with this event (Pearse et al., 2003). While contextual and other source cues are helpful in increasing children's recall of a particular episode, it is also likely that the reverse is true, that episodes themselves can be used as sources to aid in recall.

Specific episodes by their nature contain several contextual, affective, and temporal cues that can be used later to recall a particular strategy, lesson, or fact (Pillemer, 1998). The purpose of the present study is to investigate both gender and developmental differences in children's use of episodes as salient sources of information both in their natural classroom environment as well as in a more traditional source monitoring task. Specifically, experiment one will investigate children's use of specific episodes in recalling answers to general knowledge questions and experiment two will investigate children's ability to use an episode as a source cue in when they are presented with episodes by an experimenter (thus making an other versus other distinction). It is hypothesized that children will benefit from having the additional cues present in the episode to help them recall target facts as well as the source of those facts. However, as has been seen in the literature on the development of source monitoring ability, there are likely to be developmental trends in children's ability to use narrative sources. Specifically, it is hypothesized that older children will show more benefit than younger children because they have a more developed ability to connect a piece of information with its source.

Furthermore, although no previous studies have found gender differences in children's source monitoring, it hypothesized that when the source is an episodic narrative, girls will outperform boys on tasks of source monitoring, regardless of type of source distinction. The reason past studies may not have found gender differences in source monitoring is because of the sources they used. While in many situations the goal of the to-be-recalled material was an event (i.e. Bright-Paul et al., 2005; Ceci, Crotteau-Huffman et al., 1994; Ceci, Loftus, et al., 1994; Pearse et al., 2003; Poole & Lindsay, 2002; Thierry et al., 2001), in no case was the source of the material an event. Therefore, while all of the past studies reported using populations where girls and boys were equally represented, it is likely that the type of source used made it impossible for any gender differences to be detected. In contrast, since girls outperform boys on episodic memory tasks (Herlitz & Yonker, 2002; Pillemer et al., 2003; Ross & Holmberg, 1992; Boman, 2004) and because parents model for girls a more episodic recall style (Reese & Fivush, 1993), narrative source may be particularly salient to them and including them in a traditional source monitoring task may allow for the detection of previously unseen gender differences. If gender differences are found in young preschoolers and school-age children on measures of source monitoring, this is evidence that girls are using a different cognitive strategy to recall information.

However, if gender differences are not seen on a traditional task of source monitoring, this may be because of inherent differences between the task and children's natural classroom environment. Whereas in the classroom and in standardized testing situations, children are permitted to use any recall strategy that suits them, in traditional source monitoring tasks all children are explicitly asked to recall the source of a piece of information. Therefore, it is likely that both boys and girls recall the episode in which they learned a piece of information, but only girls elect to use and report this episode using their natural recall strategies. Thus, there may be gender differences in the preference for using an episodic source, but not necessarily in the ability to recall the episodic source. This early difference in preference for a more episodic recall strategy can offer insight into why females outperform males in the classroom, but do not perform as well as males on standardized measures, namely measures of math and science aptitude.

CHAPTER VI

THE EXPERIMENTS

Pilot Study 1

The pilot study was a replication of Leichtman et al.'s (2007) procedure with a sample of college students. The purpose of the pilot study was to determine whether gender differences in the use of episodic memory persisted into early adulthood. It was hypothesized that, just as in the middle school sample, female students would report using more episodic memories to help them solve exam questions than would males. It was further hypothesized that the use of episodic memory would positively correlate with exam performance. If gender differences in the use of episodic memory were found in this later stage of development, it would give further evidence to the existence of differing cognitive strategies.

Method

Participants

One hundred and ninety-one undergraduate students (29 males, 162 females) from an introductory nutrition class at public university in New England participated in the pilot study. Approximately 20% of the students enrolled in the course completed the questionnaire. Table 1 details the characteristics of the pilot sample. Males were slightly older than females (*M* for Males = 20.4 years and *M* for females = 19.6 years) and had been in college for a longer period of time (*M* for males = 2.7 years and *M* for females=

Table 1. Characteristics of the sample used in the pilot study 1.

	Males (n=29) M (SD)	Females (n=162) M (SD)
Age[a]	20.38 (2.15)*	19.61(1.63)
GPA	3.31 (.41)	3.19 (.39)
Year in college[a]	2.71(.72)*	2.21 (.94)

*P<.05
[a] Males >Females

2.2 years). However, both males and females had similar grade points averages (*M* for males = 3.3 and *M* for females = 3.2). Participants were recruited by their classroom professors who informed them that following their next scheduled exam, they would have the option to complete a questionnaire asking them to indicate how they answer exam questions. Although students were from multiple sections of the same course, they all completed the same exam. They were told that the purpose of the study was to investigate how students answer exam questions and could be useful in developing better ways to present classroom material. Participants were informed that their participation was both voluntary and confidential and would have no impact on their exam grade.

Materials

The questionnaire consisted of five randomly-selected questions from the students' exam. Questions were printed exactly as they appeared on the exam and students were asked to write the answer that they had written on their exam just moments earlier (see Appendix A). Following each question, students were asked to choose between four options describing how they knew the answer to each of the questions. The four options were similar to those used by Conway et al. (1997) and included: a) remembering the moment you learned the answer, b) just knowing the answer, c) guessing the answer, and d) using another problem-solving strategy. Each of these options was described in detail in the instructions to the questionnaire (see Appendix A). For options b and c, participants were merely asked to indicate the letter choice, but for options a and d they were asked to elaborate on the specific moment or problem strategy they used to determine an answer. Each questionnaire and instructions were printed on blue paper to distinguish them from the students' exam.

Procedure

On the day of a regularly scheduled mid-term exam in their introductory nutrition class, all students were given a brief questionnaire along with their exams. Students were informed that participation was voluntary and that they should complete their exam entirely before beginning the questionnaire. Students were asked to read the instructions thoroughly before beginning the questionnaire. Pilot work indicated that students were able to use the written instructions to distinguish between the four options. Regardless of whether students chose to complete the questionnaire following their exam, they returned the questionnaire (either blank or completed) to a research assistant at the front of the lecture hall and were then given a short debriefing form detailing the purpose of the study.

Results

Responses for each memory option were collapsed across the five questions for each participant to create a total count of the instances that the participant reported using each option on the sampled questions. Differences between genders for each option were determined using independent samples t-test with alpha = .05 unless otherwise stated.

Gender differences in recall strategies

Table 2 shows the mean number of memory options reported by each gender across the five exam questions. While both males and females reported using specific episodes, females were significantly more likely to reporting using a particular episode to answer exam questions, $t(189) = -.3.367$, $p=.001$. In contrast, males were more likely to report using another deduction method (i.e. memory option d) to arrive at the answer $t(189) = 2.440$, $p=.016$. This pattern of results was consistent even when memory options

Table 2. Mean number of each memory option selected by participants of each gender

	Males (n=29) M (SD)	Females (n=162) M (SD)
Remember the Moment (Episodic)[a]	.90 (.94)	1.753(1.31)
Just Know (Semantic)	1.55 (1.18)	1.39 (1.19)
Guess	1.55 (1.12)	1.20 (.89)
Other Strategy [b]	1.00 (1.10)	.57 (.82

*p<.05

[a] Female >Males

[b] Males > Females

that led to incorrect answers were removed from the analyses, $t(189) = -2.932$, $p=.004$ and $t(189) = 2.554$, $p=.011$, respectively. Thus, the use of an episodic style appears to be beneficial to female students in not only arriving at an answer, but in arriving at the correct answer.

Relationship to test performance and overall grade point average

To determine the degree to which exam performance was related to the use of episodic memory, the number of specific episodes reported was correlated with the number of correct answers on the five randomly selected questions. There was a positive correlation between number of questions answered correctly and the number of specific episodes reported for both female ($r= .164$, $p =.040$) and male students ($r=.208$, $p= .139$). There was no significant correlation between episodic memory style and overall GPA ($r= .112$, $p=.252$).

Discussion

Congruent with the findings of Herbert and Burt (2004) and Conway et al. (1997), both males and females reported using specific episodes. However, as was found in Leichtman et al.'s (2007) sample of middle-school students, females reported using significantly more episodic memories to recall classroom material. This supports the hypothesis that a more episodic style would be beneficial to both genders, but especially beneficial to females. The benefit of recalling specific episodes can be seen in female students' narrative responses. For example, one female student reported knowing the definition of osmosis by recalling what the slide describing the phenomenon looked like. She stated that, " I remember the pictures of the glass with water and salt and how the water moves from one space to the other."

As hypothesized, recalling specific episodes was positively related to the number of correct answers for females and males. This indicates that in both adolescence and young adulthood, students benefit from recalling specific episodes. However, contrary to hypotheses and past research with adolescents (Leichtman at al., 2007), the use of an episodic recall style was not related to overall academic performance as measured by the students' GPA. There are two possible explanations for this finding. The first is that the vast majority of students in this sample were in their first or second semesters of college. Thus, several students could not report a cumulative GPA and those who did report a GPA were basing it on only one or two semesters of course work, making it likely that GPA was not an accurate measure of long-term academic performance in this study. Secondly, as was found by Conway et al. (1997), the use of an episodic style is not equally beneficial in all courses, especially when the material demands a more general knowledge base. Therefore, the recall of specific episodes may not correlate with overall GPA as not all course material lends itself to episodic recall. Rather, the recall of specific episodes is more likely to correlate with performance within specific course and exam questions, as was seen by the significant positive correlations between exam questions answered correctly and number of episodes recalled by female students.

Overall, the findings of the pilot study indicate that, even later in development, gender differences in the use of episodic memory are seen. The fact that these differences are seen both in early adolescence and at the conclusion of this stage in early adulthood supports the existence of differing cognitive strategies in males and females. However, because gender differences in performance and participation in male dominated fields are still present in the college years, it is difficult to discern whether differing cognitive strategies lead to or are a result of these gender differences in performance. To assess the degree to which differing cognitive strategies actually lead to differences in performance in male dominated disciplines, it is important to assess these cognitive strategies before children show differences in performance. This was the focus of experiment 1.

Experiment 1

As mentioned previously, children do not begin to show significant differences in performance on math and science aptitude tests until adolescence (Leahey & Guo, 2001; Hyde, et al., 1990). However, due to gender differences in early parent-child memory conversations in which girls experience more elaborations in memory conversations (Reese & Fivush, 1993), it is possible that girls come to prefer a more episodic recall style very early in development. Thus, this preference may be seen before actual performance differences are evident. Alternatively, it is possible that young girls and boys may not have internalized a different problem-solving style early in development in spite of the differing models they have for memory talk. If this is true, then differences in performance appear in adolescence because this is when girls and boys come to rely on differing cognitive strategies. Experiment 1 focused on the use of episodic memories to answer test questions in math, science, and social studies. Since this study focused on a broad age range to determine how early in development children recruit specific episodes from memory to help them recall important material and when in development gender differences in this ability may emerge, children were asked a series of age-appropriate general knowledge questions. This made it possible to include young preschoolers who may not have any experience with classroom tests, as well as elementary students from diverse educational backgrounds.

Method

Participants

Eighty children (40 male, 40 female) were recruited through summer camps and pre-kindergarten and kindergarten programs in New England. Children were divided into groups based on gender and age, The final sample consisted of, 20 4-5-year-old girls (M = 4 years, 11 months), 20 4-5-year-old boys (M= 5 years, 1 month), 20 7-9 year old girls (M= 8 years, 11 months), and 20 boys (M= 8 years, 8 months). Informed consent was obtained via a signed permission slip sent home in advance to each child's parents. Verbal assent was obtained from all of the children prior to each interview and children were assured that there was no right or wrong answer to any of the interview questions.

Procedure

Following a memory-for-location activity, children were asked six general knowledge questions (see Appendix B) that they may have learned previously. The questions were taken from the Brain Quest Quiz game (Feder, 2005). Brain quest quiz games are designed to test children on knowledge they should have learned in their classrooms during a particular grade level. Children were asked the set of general knowledge questions that was one year below their developmental level. For example, kindergartners were asked the questions intended for preschoolers (4-year-olds). This was to ensure that all children were familiar with the topics presented in the questions. Children were asked six of these questions, 2 math questions, 2 science questions, and 2 social studies questions. The math questions were chosen from the selection of questions within the math category of the Brain Quest game. However, because both science and social studies questions are grouped into one general social studies category within the Brain Quest game, for this study, science questions were defined as those questions referring to biology and natural sciences and social studies questions were defined as those questions referring to history or geography. The order of the questions was randomized and counterbalanced across genders.

All children were interviewed about the general knowledge questions using a set of scripted interview questions (see Appendix C). The researcher began each interview by explaining that some people answer questions by remembering the moment they learned the answer, and that some people just know the answer, but cannot remember the moment that they learned the answer. The children then heard two examples of people who use each of these ways of problem solving and were asked to indicate if the person in the example remembered the moment they learned the answer or if they just knew the answer. If children gave an incorrect response they were given appropriate corrective feedback and the training item was repeated. All children were able to make the distinction between just knowing the answer and remembering the moment one learned the answer in training, however 45% of the 4-5-year-olds needed to have at least one example repeated.

Children were then asked the six questions and how they answered them. The researcher first read the questions aloud to the child and paused for them to answer. If a child insisted that they did not know the answer, the researcher moved on to the next question. After the children had given an answer, the researcher asked the children to indicate if they knew the answer to the question or if they had guessed. When children answered that they had guessed the answer, the researcher moved to the next preselected question. If children answered that they knew the answer then the researcher asked if they remembered the moment they learned it or if they just knew the answer. If children indicated that they remembered when they learned the answer, then they were asked to tell the researcher everything that they remembered about the moment they learned the answer. Following this free report, children were asked five specific follow-up questions including; 1) how old were you? 2) where were you? 3) who was there? 4) what happened when you learned the answer? 5) what did you see and hear when this happened? If children had already given this information then the information was repeated to them as a response to the question (i.e. where were you? You said you were sitting at the science corner). In this way, each child was allowed to correct the researcher if there was a misunderstanding. This process of obtaining the child's answer, memory response, and free report was repeated for all six questions.

Children's answers were recorded using a standard tape recorder. The recordings were transcribed following the completion of the interview.

Coding

All children's narrative responses were coded separately for both their responses to the open-ended question alone (i.e. their free report) and their total responses to both the open ended and directed follow-up question (i.e. their total report). All episodes were coded by one main coder and then a subset (20%) of the transcripts were recoded by a second coder to establish inter-rater reliability. The two coders were reliable on 85.5% of the transcripts.

Total words, adjective and adverbs, and emotions words. The total word count, as well as the total number of adjectives and adverbs, and emotion words were calculated for both children's free and total reports. Any unintelligible utterance or non-word utterances (uh, um, etc.) were not included in the word counts. Each occurrence of an adjective, adverb or emotion word was counted, regardless of whether it had occurred previously in the episode, thus it was count of each utterance, not each distinct occurrence.

General versus specific memories. Since past research (Goddard et al., 1998) has indicated that even when participants are asked to give specific, one-moment-in-time, episodes, they often give what would be considered to be general event memories, children's narrative responses were coded as either general or specific using the criteria established by Pillemer, Goldsmith, Panter, and White (1988). *Specific memories* were defined as being descriptions of one-moment-in-time events that occured on one day. Children could indicate that a memory was specific by labeling the exact location ("I learned it while I was sitting in science corner), the time ("I learned it last Thursday in class), the people involved, ("My teacher told my friend that that was the correct answer"), or another detail of the event that indicated it had occurred only once. *General memories* were defined as being descriptions of events that happened more than once or that occurred over an extended period of time. Children could indicate that a memory was general by stating that the event occurred often (" The teacher wrote it on the board every day") or over an extended period of time such as an entire month or year. In addition to these two memory codes, three additional codes were created to capture the diversity of episodes provided by this younger age group. The first, *consistent with specific*, was given to memories that lacked sufficient detail to be defined as specific, but were not general memories (" I learned it in the book"). The second code, *procedural*, was used to define situations in which the child gave no memory, but instead described how he or she solved the problem (" I added up the numbers"). Finally, a *no memory* code was used to define instances where children claimed to remember a specific moment but could not provide a memory. These codes were given based on the child's narrative statement, not on his or her labeling of the event as either semantic (I just knew it) or specific (I remember when I learned it).

Direct and indirect speech. All narrative responses were coded for instances of direct or indirect speech. Instances of direct or indirect speech were identified using the definitions described Ely, Gleason, and McCabe (1996). According to these definitions, instances of direct speech were defined as any instance within the episode where the child repeated what another person said in a way that appeared to be almost verbatim (however, the child does not need to be accurate) as if the child were speaking for another person (e.g. My teacher said, "congratulations, you got it right!"). In contrast, indirect speech was defined as an instance where the child paraphrased a dialogue sequence that has occurred in the past and thus did not use phrases that appeared to be verbatim (e.g. my teacher said I got it right).

Mention of others. Similar to the codes used by Buckner and Fivush (1998) the number of times that children spontaneously mentioned non-specific others (people in my class, the girl at my table, and pronouns including he and she), relationships between themselves and others (friend, mother, sister), and proper names (Sally) in their spontaneous narrative were recorded.

Location. Specific locations that children mentioned as the primary location of the learning event were coded as being at home, school, or other location. If a location was mentioned, but was not the primary learning location, it was not coded.

Learning activity theme and content. Children's descriptions of the activity in which they learned the target information were coded for both theme and content. The theme of each episode provided by the child was coded as either individual, social, or not mentioned (Buckner & Fivush , 1998). Congruent with the codes developed by Buckner and Fivush (1998), an episode was coded as individual if the child reported that the primary learning occurred without another person's input (e.g. "I read it in my book one night"). In contrast, an episode was coded as social if the child reported that another person played a key role in the learning process and in fact the learning event may not have occurred without this person (e.g. "My mom read that to me from my textbook one night").

In addition to the theme of learning activity, the content of the activity itself was coded as well. Specifically, learning activity content was coded as being primarily visual (i.e. the child reports seeing the information on a map or a picture), spoken (i.e. the child was told the fact by a teacher or parent), read (the child read the information in a book or on a worksheet), or the material was part of an activity learning process in which the child somehow initiated or sustained the learning activity (i.e. the child learned the information as part of a game in class).

Results

The analyses reported below were conducted on the complete data set of eighty children. Major analyses were conducted on questions within each subject area separately, however, the same pattern of results emerged. Therefore, only the analyses for all of the questions across all three subject areas are reported.

Number of questions children knew and number of correct responses

A 2(age; 4-5-year-old, 7-9-year-old) x 2(gender; male, female) ANOVA with number of questions children knew as the dependent variable indicated a main effect of gender, $F(1, 76) = 4.971$, $p=.029$. Girls reported knowing the answer to significantly fewer questions ($M= 3.8$, $SD = 1.71$), than did the boys ($M= 4.570$, $SD = 1.62$). There were also significant age differences in the number of questions children knew, $F(1, 76) = 13.455$, $p<.001$. Four-five-year-old children reported knowing significantly fewer answers, ($M= 3.55$, $SD = 1.96$), than did 7-9-year-old children, ($M= 4.825$, $SD = 1.08$). There was no significant gender by age interaction for questions the children knew, $F(1, 76) = .005$, $p=.943$.

An additional 2(age) x 2(gender) ANOVA with number of questions children answered correctly as the dependent variable indicated a main effect of gender, $F(1,76) = 9.5$, $p=.003$, and age $F(1, 76) = 4.22$, $p=.043$. Girls answered significantly fewer questions correctly, however, both genders did answer the majority of the questions correctly, girls ($M= 5.0$, $SD = 1.06$) and boys ($M= 5.6$, $SD= .67$). Four-five-year-olds answered more questions correctly than did 7-9-year-olds, ($M= 5.5$, $SD = .78$) and ($M= 5.1$, $SD = 1.03$), respectively. There was no significant age by gender interaction, $F(1, 76) = 1.056$, $p=.307$.

Number of episodes reported

A 2(age) x 2(gender) ANOVA indicated that there were no significant gender differences for number of episodes reported, $F(1,76) = .208$, $p=.650$ Both gender groups reported a similar number of episodes when answering the general knowledge questions with boys reporting (M = 2.0, SD = 1.88) episodes and girls reporting (M = 2.175, SD = 1.70) episodes. Similarly there were no significant gender differences in the proportion of boys and girls who reported recalling at least one episode, $\chi 2 = (1, N= 80) = 1.614$, p=.310, with 67.5 % of boys and 80% of girls reporting recalling at least one episode . To determine whether there were differences in the percentage of episodes recalled when children reporting knowing the answer, the proportion of episodes reported for answers the children knew was calculated by dividing the total number of episodes that children reported by the total number of answers that they reporting knowing. A 2(age) x 2(gender) ANOVA using the percentage of episodes for known answers as the dependent variable, indicated that there was a marginally significant gender difference in the percentage of episodes reported for answers the children knew , $F(1,76) = 2.979$, p=.088 . While girls reported recalling an episode for 56% of the questions they knew, boys reported recalling an episode for only 42% of the answers they knew. However, when this analysis was repeated using only correct responses (i.e. the proportion of memories given for questions that children reporting knowing and had gotten correct) there was a significant effect of gender, F(1, 76) = 3.997, p=.049 with girls recalling an episodes for 57% of the questions they knew and boys recalling an episode for 40% of the episodes they knew. Thus, there are gender differences in the quantity of episodes children remembered, especially in the case where children both knew the answer and had gotten it correct.

There were significant age differences in the total number of episodes reported, $F(1,76) = 9.362$, p=.003, with 4-5-year-old children (M= 1.5, SD= 1.68) reporting fewer episodes than 7-9-year-old children (M= 2.68, SD= 1.72). Also, only 62.5 % of the 4-5-year-old children reported recalling at least one memory whereas 85% of 7-9-year-old children reported recalling at least one memory and this difference was significant, $\chi 2$ (1, N= 80) = 5.230, p=.041. Finally, 4-5-year-olds were slightly less likely to recall an episode for an answer that they knew, $F(1, 76) = 3.050$, p=.085, they reported an episode for 41% of the answers they knew and 7-9-year-old children reporting an episode for 56% of the answers they knew. There was no significant age by gender interaction for number of episodes, $F(1, 76) = .004$, p=.948 or proportion of episodes for answers children knew, $F(1, 76) = .057$, p=.813. Table 3 summarizes the findings for the number of questions children knew, the number of answers they got correct, the total number of episodes reported, and the proportion of episodes for known questions.

Narrative responses

The analyses reported below were conducted on the subset of children who reported at least one episode in response to the general knowledge questions. Specifically, this subset of participants included 27 males (11 4-5-year-olds and 16 7-9-year-olds) and 32 females (14 4-5-year-olds and 18 7-9-year-olds). The total number of instances for each code (i.e. mention of others, direct and indirect speech, etc.) were calculated for both the children's free and total reports. This total number of instances for each code was then divided the number of episodes the child reported, to create an average value for each code. The average values for total and free report were analyzed separately, however, since there were few differences between the children's free and total report, only the total report is reported here. There were only eight instances where a child gave an episode for an incorrect answer to a question. These episodes were

Table 3. Number (and standard deviation) of known questions, correct responses, episodes, and proportion of episodes for known questions for each age and gender group.

	Males		Females	
	4-5 years	7-9 years	4-5 years	7-9 years
Questions known[a,b]	3.95(1.85)	5.20(1.06)	3.15(2.03)	4.45(1.00)
Correct Responses [a,b]	5.70(.66)	5.50(.69)	5.30(.86)	4.70(1.17)
Number of Episodes[b]	1.40(1.76)	2.60(1.85)	1.60(1.64)	2.75(1.62)
Proportion of Episodes[c,d]	.34(.38)	.50(.30)	.50(.44)	.62(.33)

[a]Females>Males, $p \leq .05$
[b]7-9-years>4-5-years, $p \leq .05$
[c]Females >Males, $p \leq .10$
[d] 7-9-years>4-5-years, $p \leq .10$

analyzed along with the episodes given for correct answers because of the small number of instances where this occurred and because the memories given for incorrect responses were not substantively different from those given for correct responses.

Average words, adjective and adverbs, and emotions words. The mean number of words, adjective, adverbs, and emotion words for both gender and age groups is presented in table 4. There were significant gender difference in both the average number of words per memory, $F(1, 55) = 5.958$, $p=.018$, as well as the average number of adjectives and adverbs, $F(1, 55) = 5.908$, $p=.018$. Girls' memories were longer and contained more adjectives and adverbs than boys' memories. There was no significant gender difference in average of emotion words, $F(1, 55) = .303$, $p=.585$, with both genders using relatively few emotion words in their memories ($M<1$ per episode).

There were also significant age differences in the average number of words, $F(1,55) = 11.401$, $p=.001$, with 7-9-year-old children reporting longer memories than 4-5-year-old children. There were no age differences in the average number of adjectives and adverbs, $F(1,55) = .253$, $p=.617$ or emotion words, $F(1, 55) = .062$, $p=.804$. Thus, children in both age groups were just as likely to use adjective, adverbs, and emotion words to add descriptive details to their episodes.

Mention of others. Table 5 summarizes the findings for children's mentions of other people in their learning episodes. References to other people were calculated separately as either mentions of specific relationships, mentions of non-specific relationships, and mentions of proper names. These individual values were also combined to create one value representing children's global mentions of any other person. Using this global value, a 2 (age) x 2 (gender) ANOVA indicated that there were significant

Table 4. Average number (and standard deviation) of words, adjectives and adverbs, and emotion words in children's narrative responses for each age and gender group.

	Males		Females	
	4-5 years	7-9 years	4-5 years	7-9 years
Number of Words[a,b]	37.42(12.74)	58.49(19.92)	50.55(32.09)	86.75(45.69)
Adjectives and Adverbs[a]	.92(1.14)	1.05(.72)	2.10(3.38)	2.52(1.94)
Emotion Words	.05(.15)	.00(.00)	.01(.05)	.08(.30)

[a]Females>Males, $p \leq .05$
[b]7-9-years>4-5-years, $p \leq .05$

Table 5. Average number of mentions (and standard deviation) of specific relationships, non-specific relationships, proper names, and total mentions of other peoples in children's narrative responses for each age and gender group.

	Males		Females	
	4-5 years	7-9 years	4-5 years	7-9 years
Specific relationships	1.93(.81)	1.78(1.08)	2.41(1.47)	1.64(1.00)
Non-specific relationships[a,b]	.24(.42)	2.31(1.20)	1.37(1.93)	4.15(3.12)
Proper names	.35(.42)	.20(.52)	.22(.70)	.22(.60)
Total mention of others[a,b]	2.53(1.16)	4.28(1.69)	4.00(2.81)	6.00(3.56)

[a]Females>Males, $p \leq .05$
[b]7-9-years>4-5-years, $p \leq .05$

gender differences in the average mention of others per episode $F(1, 55) = 5.339$, $p=.025$, with girls (M=5.13, SD= 3.36) mentioning more people in their memories than boys (M= 3.57, SD = 1.71). There was also a significant main effect of age, $F(1, 55) = 7.449$, p=.009, with 7-9-year-old children mentioning more people (M = 5.20, SD= 2.93) than 4-5-year-old children (M = 3.35, SD = 2.32). There were no significant age by gender interaction, $F(1, 55) = .035$, $p=.853$.

For the number of specific relationships mentioned and the number of proper names mentioned, there were no significant age (specific relationships, $F(1,55) = 2.397$, $p=.127$; proper names, $F(1,55) = .269$, $p=.606$), gender (specific relationships, $F(1,55)$ = .318, $p=.575$;proper names, $F(1,55) = .128$, $p=.722$), or interaction effects (specific relationships, $F(1,55) = 1.068$, $p=.306$; proper names, $F(1, 55) = .243$, $p=.624$). However, there were significant gender $F(1, 55) = 7.267$, $p = .009$ and age differences, $F($ $1, 55) = 19.424$, $p<.001$ for mentions of non-specific others. Specifically, girls (M=2.93, SD = 2.98) mentioned a greater average number non-specific others in each of their episodes than did boys (M =1.47, SD = 1.41) and 7-9-year-old children (M= 3.28, SD =2.56) mentioned more non-specific others than 4-5-year-old children (M = .87, SD = 1.56). There was no significant age by gender interaction, $F(1, 55) = .429$, $p=.515$.

Direct and indirect speech. Since instances of direct and indirect speech were relatively rare in this sample the individual instances of direct and indirect speech were combined for analyses. A 2 (age) x 2(gender) ANOVA indicate that there was a significant main effect for age, $F(1,55) = 7.943$, $p=.007$, with 4-5-year-old children (M= .21, SD = .38) using direct and indirect speech less often in their episodes than 7-9-year-old children (M = .66, SD = .74), There was no significant effect of gender ($F(1,55)$ =

.134, p=.716; boys M = .46, SD = .75; girls M= .48, SD = .57), or age by gender interaction (F(1,55) = .837, p=.364).

Location and age of memory. Table 6 lists proportion of memories that occurred at each of three primary locations (school, home, and other). There were significant age differences in the primary locations that children described in their episodes. Seven-nine-year-old children were significantly more likely to report that a learning event had occurred at school, F(1, 55) = 45.348, p<.001, whereas 4-5-year-old children were more likely to report that learning episode had occurred at home, F(1, 55) = 3.688, p=.060, or another location away from home or school, such as a park, a farm, or a grocery store, F(1,55) = 14.242, p<.001. There were no significant effects of gender (school, F(1,55) = 1.672, p=.201; home, F(1,55) = 1.671, p=.202; other, F(1,55) = .060, p=.808) or significant age by gender interactions (school, F(1,55) = .151, p=.699; home, F(1,55) = .860, p=.358; other, F(1,55) = .831, p = .366) for any of the three locations.

The average age that children reported in their episodes was calculated by dividing the total ages reported by the number of memories in which children reported an age. Only three children in the sample reported not recalling how old they were in their episodes. There were significant age differences in the mean age that the children reported F(1, 55) = 71.255, p<.001, with 4-5-year-old children reporting a younger mean age of the learning episode than 7-9-year-old children. However, whereas 4-5-year-old children reported a mean age (3 years, 3 months) that was approximately a year less than their mean chronological age (5 years, 0 months), 7-9-year-old children reported a mean age (6 years, 4 month) that was almost over two years less than their chronological age (8 years, 9 months), indicating that 7-9-year-old children were recalling more distant

Table 6. Proportion of memories (and standard deviation) that occurred at each of three primary locations for each age and gender group.

	Males		Females	
	4-5 years	7-9 years	4-5 years	7-9 years
School[a]	.08(.17)	.66(.30)	.21(.43)	.74(.28)
Home[b]	.35(.32)	.27(.30)	.32(.41)	.10(.15)
Other[c]	.42(.28)	.06(.12)	.37(.41)	.15(.28)

[a] 7-9-years>4-5-years, $p \leq .05$
[b] 4-5 year> 7-9 years, $p \leq .10$
[c] 4-5 year> 7-9 years, $p \leq .05$

material when describing learning episodes. There were no significant gender differences in the ages of children's memories, $F(1, 52) = .322$, $p=.573$ and there was also no significant gender by age interaction, $F(1,52) = 2.551$, $p=.116$.

Learning activity and theme of memory. Table 7 lists the proportion of total memories that were coded as either, visual, read, spoken, or active learning activity types. There were significant gender and age differences in the type of learning activities that children reported. Boys were more likely than girls to report a primarily visual learning activity, $F(1,55) = 6.862$, $p=.011$, but girls were more likely to report an active learning experience, $F(1, 55) = 7.057$, $p=.010$. There were no significant gender difference in either read, $F(1,55) = .179$, $p=.674$ or spoken activities, $F(1,55) = .019$, $p=.892$. Regarding age, 4-5-year-old children were more likely than 7-9-year-old children to report learning the information through a visual activity, $F(1,55) = 3.862$, $p = .054$, but were less likely to report reading the information, $F(1,55) = 7.531$, $p=.008$ or engaging in an active learning activity, $F(155) = 15.709$, $p<.001$. However, there were no significant age difference in spoken material, $F(1, 55) = 1.573$, $p=.215$, but there was a marginally significant age by gender interaction, $F(1,55) = 2.916$, $p=.093$. While males of both ages were equally like to report that they had heard the information spoken to them, post hoc contrasts within the interaction indicated that 4-5-year-old girls were significantly more likely than 7-9-year-old girls to report having heard the information spoken to them, $t(30)= 2.314$, $p=.028$. There were no other significant age by gender interactions for the learning activities (visual, $F(1,55) = 2.265$, $p=.138$; read, $F(1,55) = .179$ $p=.674$; active learning, $F(1,55) = 1.778$, $p=.188$.

Table 7. Proportion of memories (and standard deviation) for each type of learning activity for each gender and age group.

	Males		Females	
	4-5 years	7-9 years	4-5 years	7-9 years
Visual[a,c]	.43(.43)	.17(.27)	.13(.23)	.09(.18)
Spoken[e]	.31(.45)	.35(.34)	.46(.45)	.17(.25)
Read[b]	.00(.00)	.10(.17)	.00(.00)	.07(.15)
Active Learning[b,d]	.13(.22)	.34(.32)	.22(.35)	.65(.28)

[a] 4-5 year> 7-9 years, $p \leq .05$
[b] 7-9-years>4-5-years, $p \leq .05$
[c] Males>Females, $p < .05$
[d] Females>Males, $p \leq .05$
[e] age by gender interaction, $p \leq .10$

The theme of each learning activity was also analyzed using two 2 (age) x 2(gender) ANOVAs with the proportion of memories that were coded as individual and social as the dependent variables. For memories that were coded as individually themed, there was a significant main effect of gender, $F(1,55) = 4.585$, p=.037, with boys (M= .36, SD= .40) having a larger proportion of memories that were individually themed than girls (M = .20, SD = .30). In addition to this main effect, there was a significant age by gender interaction, $F(1,55) = 4.552$, p=.037, indicating that while 4-5-year-old boys had more individually themed memories than 7-9-year-old boys, the opposite was true in girls with 4-5-year-old girls having fewer individually themed memories than 7-9-year-old girls (see figure 1). For memories that were coded as being primarily socially themed, there was a small effect of gender, $F(1, 55) = 3.201$, p=.079 with both 4-5-year-old (M = .70, SD = .41) and 7-9-year-old (M = .71, SD = .33) girls having a larger proportion of memories that were socially themed than boys in either age group (M = .37, SD = .44 and M = .69, SD = .35).

Memory type: specific, consistent with specific, general, and procedural. A series of 2(age) x 2 (gender) ANOVAs with the proportion of memories coded as either, specific, consistent with specific, general, or procedural as the dependent variables were conducted to determine whether there were age or gender difference in the global type of memories that children reported. As can be seen in table 8, results indicated that there were no gender differences (specific, $F(1,55) = .320$, p =.574; consistent, $F(1, 55) = .055$, p =.815; general, $F(1,55) = .401$, p=.529; procedural, $F(1,55) = 1.783$, p=.187) or age by gender interactions (specific, $F(1,55) = .153$, p=.697; consistent, $F(1,55) = .027$, p=.869; general, $F(1,55) = .904$, p = .346; procedural, $F(1,55) = 1.783$, p = .187) for any of the

Figure 1. Proportion of episodes that were coded as individually themed.

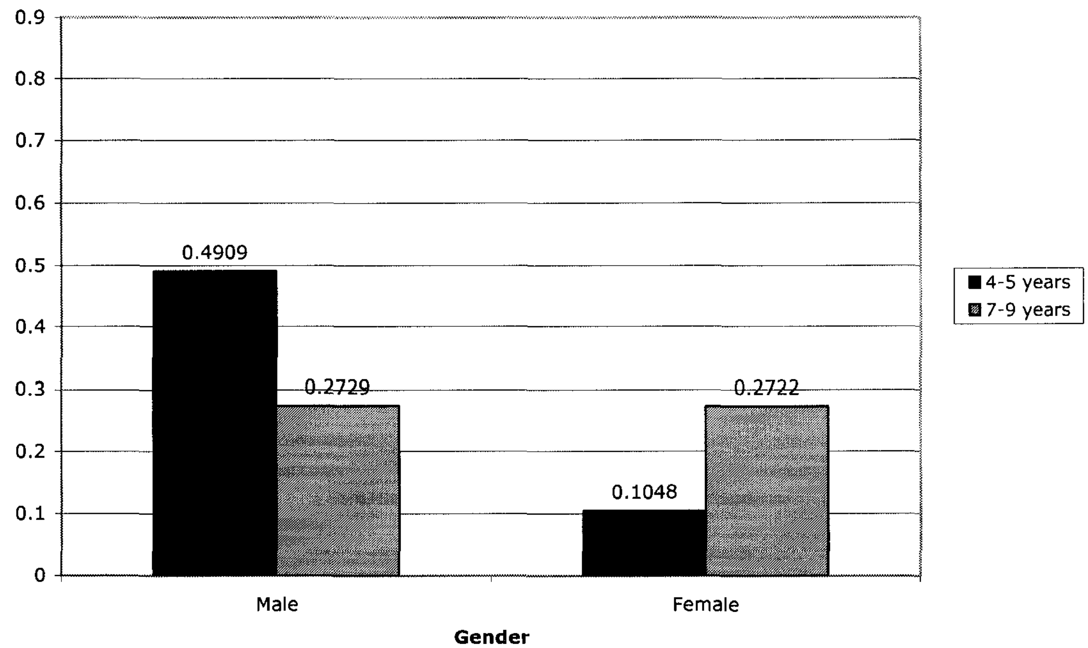


Table 8. Proportion of memories (and standard deviation) coded as either specific, consistent with specific, general, or procedural for each gender and age group.

	Males		Females	
	4-5 years	7-9 years	4-5 years	7-9 years
Specific[a]	.58(.42)	.84(.16)	.57(.39)	.75(.37)
Consistent[b]	.28(.34)	.14(.16)	.27(.32)	.11(.26)
General	.11(.20)	.02(.08)	.09(.27)	.12(.32)
Procedural	.03 (.10)	.00(.00)	.00(.00)	.00(.00)

[a] 7-9-years>4-5-years, $p \leq .05$
[b] 4-5 year> 7-9 years, $p \leq .05$

memory types. However, there were significant age differences in the type of memories reported. Specifically, 4-5-year-old children reported fewer specific memories, $F(1,55)$ 5.852 p=.019, but more memories that were consistent with specific memories, $F(1, 55)$ = 4.514, p=.038. This indicates that while 7-9-year-olds are able to provide more narratives that contain details that isolate them to one point in time (i.e., specific narratives), 4-5-year-olds give narratives that do not contain enough detail to clearly be labeled as specific, but are likely to have occurred only once (i.e., consistent with specific). There were no significant age differences for procedural ($F(1, 55)$ = 1.783, p= .187) or general memories ($F(1, 55)$ = .145, p=.705).

Discussion

The purpose of experiment 1 was to determine if there were age and developmental differences in both the quantity and quality of children's reports of learning episodes. As anticipated, there were significant age differences in the number of episodes that children reported, with younger children reporting fewer narratives. However, the vast majority of children in the 4-5-year-old age group were able to give at least one narrative episode of a learning event, indicating that they were able to complete the task at a basic level. Further, although younger children gave fewer specific memories than older children, they were more likely to give memories that were consistent with specific, but lacked sufficient detail. For example, many children in this younger age group would respond that "mommy or daddy told me that" when asked how they learned the answer to the question. While this response is not completely specific in that it lacks the details necessary to determine that the event occurred at a single time, it is also not general because the child hass indicated that they were told the information once, but just are not specifying that clearly. However, some of the younger children were able to detail a clearly specific event that met all of the necessary criterion to be considered specific. For example, one 5-year-old girl reported that she knew that you saw the moon in the sky at night "because my mommy I think when I was little showed me like she teached me how to draw the shape and then she told me like that's the shape of a moon like in the sky so I knew that that was a moon." This memory clearly indicates a specific event in that the child details a specific activity and even marks it with a conversational exchange that occurred. The fact that young children gave these kinds of narratives with minimal prompting or support from the interviewer indicates that young children can recall a specific learning episode and that the only difference between their memories and those provided by older children is the level of detail needed to clarify these memories as specific. That is, younger children are not merely providing general memories of routine events in response to a request for a specific event, but they are at an intermediate level of providing specific memories.

The hypothesis that girls would report more episodic memories than boys was supported. While girls and boys reported and almost equal number of memories when they were asked about the moment they learned the answer to the general knowledge questions, when the subset of questions that children both knew and answered correctly was analyzed there were significant gender differences. This is congruent with past studies of middle school (Leichtman et al., 2007) and college students (pilot study 1) where females reported significantly more memories than did males. This is surprising given that children in this age range are still developing the metamemory skills that they need to understand their own learning (Lockl & Schneider, 2007; Ornstein & Haden, 2001). Thus, the fact that gender differences are seen at this relatively immature state is particularly compelling. Yet, both boys and girls in this younger sample gave a similar proportion of memories for questions they answered to the female college students in pilot study 1 (younger children, 35% vs. female college students, 32%), indicating that these children did understand the concept of episodic recall. However, it is possible that because the younger children have a limited the understanding of what it means to use and recall an episodic memory, the memories they gave in response to the questions may have been more to provide some narrative event in order to answer the experimenters question.

There were also differences in the quality of narratives that children of each gender provided. Across age groups, girls provided more details in their narratives in that their narratives were overall longer and they provided a greater number of adjectives and adverbs. This is consistent with the findings that women provide more details in their memories both in experimental (Herlitz & Yonker, 2002) and interview contexts (Pillemer et al., 2003). Not only did girls provide more details in their narratives they were also more socially focused, in that they had more mentions of other people in their narratives and congruent with Buckner & Fivush (1998) they had a greater proportion of learning episodes that were socially themed, meaning that other people were not merely mentioned, but they played a key role in the learning event. For example, one girl in the older age group recalled a moment when she was playing a trivia game in class that helped her to recall that the United States was a country and not a continent. She said, "When I was in second grade we learning about the earth and um all the people waving raising their hands for the answer everyone was going to say continent because um..everyone was whispering it's a continent..it's a continent..it's a continent to each other and I'm like what well I am just going to try country she told everyone said no..no..one more that's you and I guessed country and she's like we have a winner and I won a piece of candy." In this narrative the child mentions her friends and classmates as well as her teacher and a central focus of this narrative was the way in which these people contributed to her learning that the United States was a country. In contrast, to the more socially themed provided by the girls, boys were more likely to provide individually themed narratives where they were the only agent in the learning event. For example, in response to the same question about the United States a boy in the older age groups recalled that "At school we were um we were learning about immigrants and things like that and um…and then we had like our big maps and one time I read the map and it said that the United States was a country." In this instance the child mentions people only as contextual information, but he himself was the main focus of the learning event.

In addition to being more socially focused girls' were also more likely to describe narratives in which they were engaged in an active learning experience. This indicates that girls were more likely to report being actively involved in their own learning by either initiating or maintaining a learning episode than were boys who were more likely to report a visual activity where they passively saw the information either in a textbook or illustration. The fact that girls are reporting more active learning experiences than boys could indicate that interactive learning experiences are particularly memorable for them and thus may be important for their later recall of target material. Also, active learning experiences, as they were defined in the present study, were indicators of a time when the child played a pivotal role in creating their own learning episode and thus are indicators of memories that are not only episodic memories, but personal event memories that are personally meaningful to the child (Pillemer, 1998). The fact that girls are recalling these kinds of episodic memories to a greater extent that are boys could indicate an early preference for a more narrative based recall in which learning activities are best recalled in the context of a learning episode that was meaningful because "it happened to me." Future research is needed to investigate the role of personal event memories in recall.

Overall the findings of experiment 1 indicate that there were both developmental and gender differences in the learning episodes that children provided for general knowledge information. Children as young as 4 were able to give reports of learning episodes, but these episodes contained fewer details to clarify them as specific memories. Also, there were some gender differences in the types of episodes that children of both age groups reported. Girls reported more social memories and were more likely to report active learning events. This may indicate a preference for personally experienced events in recall and may explain why over the course of development recalling these meaningful episodes may become a useful memory strategy for girls. However, it may also explain why girls struggle to apply an episodic strategy to subject areas, including math and science, where information is much more acontextual and thus less likely to become a personal episodic memory. Further, as was previously mentioned, on standardized tests of math and science in particular recalling a learning episode may be counter-productive for girls in that it focuses their attention to contextual details that may not quickly lend themselves to the recall of the target material.

Unlike in the previous studies of episodic recall (i.e. Leichtman et al., 2007 and pilot study1), experiment 1 asked children to recall memories for acquiring general knowledge rather than classroom material. This may have limited the number of specific episodes that children reported because general knowledge may have been acquired over a longer period and the children have more semantic than episodic memories for this type of information. Therefore, in order to compare the trends seen in the college and middle school samples with the trends seen in experiment 1, it was necessary to focus on information that was recently presented to children in their classrooms. This was the focus of pilot study 2.

Pilot Study 2

The purpose of this exploratory study was to determine the degree to which the patterns seen in a large age range of children in experiment 1 as well as the gender differences seen in the college classroom in pilot study 1, could be replicated in a more natural classroom environment. Eight-year-olds were the focus of this exploratory study, as children of this age are beginning to use organized recall strategies, but are not yet showing gender differences in performance on standardized tests of aptitude in stereotypically male disciplines.

Method

Participants

Nineteen third-graders, 11 males (M = 9 years, 3 months) and 8 females (M = 9 years, 4 months), were recruited from two third-grade classrooms in a private elementary school in New England. While both classrooms gave tests in math during the course of the experiment, only one classroom gave tests in social studies and science. Thus, not all children completed interviews in all subject areas. Specifically, 18 children completed the math interview, 8 completed the science interview, and 11 completed the social studies interview. All of the children were Caucasian and from middle class families and no children were receiving special educations services. Informed consent was obtained via a signed permission slip sent home in advance to each child's parents. Additionally, the permission slip gave parents the option to allow the researcher to obtain the child's grades in math, science, and social studies. All parents consented to having this information released. Verbal assent was obtained from all of the children prior to each interview and Children were assured that there was no right or wrong answer to any of the interview questions.

Procedure

All interviews were completed the morning following an afternoon test in either math, science, or social studies, with the exception math class B where the interview was completed two days after the scheduled test. The same structured interview used in experiment 1 was used in this exploratory study, with only exception being that children were interviewed a maximum of three separate times, one interview for each subject area. Also, whereas in experiment 1 children were read questions that were new to them, in pilot study 2, children saw a copy of their tests again and were asked to indicate how they knew they had previously answered the question. Prior to interviewing the children, the experimenter randomly selected five tests questions from each subject test to be used in each interview and collected all of the children's completed test from their teacher. All children were asked about the same test questions and in the same predetermined order. Although the topics being covered in the two classrooms varied, the math tests for both classes focused on the understanding of money and adding with decimals. Since students in classroom A were the only participants who completed tests in science and social studies during the course of the experiment, test materials were identical in these subject areas. The science test focused on the three states of matter and the social studies test focused on location, abbreviations, and capital cities of a set of states.

Coding

All children's narrative responses were transcribed and coded using the same codes described in experiment 1, including, total words, total number adjectives and adverbs, total number of emotion words, general vs. specific memories, direct and indirect speech, mention of other, location, and learning activity content and theme. Reliability was also achieved by two independent coders and just as in experiment 1, reliability between the coders was 85.5%.

Results and discussion

Due to scheduling conflicts, only 8 children completed interviews in all three subject areas with the other 11 participants only completing interviews in math only or social studies and science only. Since this data included such a small sample of students, results will be collapsed across subject areas and only trends seen in the means for both genders will be discussed as significance tests would be inappropriate.

Similar to the findings from experiment one, girls did not report more total memories than did boys, (M= 2.20, SD = 1.1.4 and M=2.15, SD = 1.14, respectively). However, in contrast to experiment one girls did not report knowing fewer answer than did boys, (girl M= 4.21, SD =.92 and boys M= 4.24, SD = .63) nor did they get fewer answer correct than boys (girls M=4.5, SD = .64 and boys M=4.5, SD = .50). There was also no difference in the proportion of episodes that girls (*M* =.50, *SD* =.22) and boys (*M* = .50, *SD*=.23) reported for answers they knew.

While there were no gender difference in the quantity of episodes girls and boys provided, similar to experiment one there were several qualitative differences in what girls were reporting in their memories. Table 9 summarizes the main gender differences in the narratives that the children reported. Girls reported slightly longer narratives, but their narratives did not contain more adjective and adverbs than did boy (girls *M* = 1.02, *SD*=.89 and boys *M*= 1.32, *SD*=1.59) or more emotion words than did boys (girls *M*= .03, *SD* = .09 and boys *M* = .08, *SD* = .17). However, unlike in experiment one girls did use more instances of direct and indirect speech and had more memories that were coded as being specific which could be an indicator of narrative that are more embellished and more specifically isolate one moment in time events.

Also congruent with experiment 1, girls were more social in their episodes in that their episodes were more frequently coded as social and they also mention more people in total than did boys. However, there were no differences in the kinds of locations or learning activities that boys and girls reported, with most children reporting having learned the material in school (girls *M*= .73, *SD* = .36 and boys *M*= .71, *SD* = .36) by hearing the material spoken to them (girls *M* = .32, *SD* = .32 and boys *M* = .25, *SD* = .34) or engaging in an active learning activity (girls *M* = .33, *SD* = .34 and boys *M*= .36, *SD* = .38).

While only trends could be discussed in this data due to the small number of children interviewed, these trends are congruent with experiment 1 as well as with other findings on gender differences in episodic memory. Girls in this sample were more likely

Table 9. Average number (and standard deviation) of words, instances of direct and indirect speech, mention of others, and proportion of socially themed memories and specific memories for each gender

	Males	Females
Number of Words	66.31(43.15)	69.56(21.76)
Direct and Indirect speech	0.51(0.57)	0.68(0.61)
Total mention of others	3.35 (1.99)	3.92(1.39)
Socially themed memories	0.49(0.39)	0.71(0.33)
Number of specific memories	0.53(0.33)	0.76(0.38)

to use direct and indirect speech than were boys which is congruent with the findings of Ely et al. (1996) who found that by the age of 5 years girls were using direct and indirect speech in their narratives more than twice as often as boys of the same age, regardless of whether they were speaking with their parent or an experimenter. The inclusion of more instances of direct speech and indirect speech is also reflected in the fact that girls' memories were more likely to be coded as specific. This could be due to the fact that, like research with women both in natural (Pillemer et al., 2003; Ross & Holmberg, 1993) and experimental contexts (Lewin et al., 2001; Herlitz & Yonker, 2002) has found, girls more readily describe specific memories rather than general memories and they may be using direct and indirect speech as a method of marking these events as one moment in time occurrences.

In addition to being more specific in nature girls' memories were more socially focused both in their overall theme as well as in the number of people mentioned. The social nature of girls' and women's narratives is a consistent theme in the literature with most studies on gender differences in episodic memory finding that both women and girls are more relationships oriented in their episodic recall (Buckner & Fivush, 1998; Leichtman et al., 2008; Pillemer et al., 2003).

Contrary to expectations, there were no significant gender differences in the quantity of memories children provided. There are two possible explanations for this. The first is that even in experiment the only slight differences in amount of episodes reported was in the proportion of episodes for questions children knew and thus because this sample was so small, it was impossible to see such a slight differences. The second explanation could be that at this young age girls are only beginning to show differences in their episodic recall (as is evidenced by the qualitative differences in their narratives) and thus the large differences in the number of episodes provided seen in the study by Leichtman et al. (2007) are not as robust in this younger age group. Future research using both a larger sample of children as well as more diverse age group, including both younger and older children, would be necessary to further investigate the nature of gender differences in the recall of classroom episodes.

Another explanation for why children in both pilot study 2 and experiment 1 did not show gender differences in the quantity of narratives they reported could be the differing degrees of attention that children give to classroom episodes. In fact, Kenney-Benson et al., (2006) have found that girls are less disruptive in class making it more likely that they will be attentive to classroom events and thus girls and boys may receive different amounts of information on target. Therefore, in order to assess gender differences in episodic recall and the possible mechanism behind it in this younger age group, it is necessary to control for possible difference in attention and type of information that children receive. This was the focus of experiment 2.

Experiment 2

The naturalistic nature of pilot study 2 offers insight into how children encode and recall information in their typical classroom environment. However, this design does not allow for experimental manipulation of the environment making it difficult to isolate specific cognitive mechanisms that may underlie gender differences in recall style. As proposed earlier, one mechanism that may be involved in such differences is source monitoring ability. According to the source monitoring framework (Johnson et al., 1993), episodic narratives may prove to be salient sources of information because they provide many temporal and contextual cues that can be used in recall. Therefore, the purpose of experiment 2 was to extend the method used in pilot study 2 and experiment 1, by using a more controlled procedure in which source monitoring ability can be isolated from aspects of the learning environment. The purpose of experiment 2 was to examine the effect of a narrative episodic source (i.e. a narrative experienced on a single occasion) on a traditional memory for location source monitoring tasks (Gopnik & Graf, 1988; Leichtman et al., 2001).

Method

Participants

The same group of 80 children who completed experiment one also completed experiment two.

Materials

Three 2 x 3 structures were created to resemble three separate "buildings" with six rooms. The structures were made from 6 individual plastic, screw-top, storage containers that were stacked on top of each other with the opening facing outward (see Appendix D). Each opening was marked with a number (1-6) so that children were able to easily distinguish one "room" of the building from the other. Each building sat on wooden frame designed to hold it in place and to maintain a constant distance between each building. Each building was a distinct color and was labeled as either "The school" (blue building), "The house" (red building), or "The grocery store" (yellow building).

Miniature objects were placed inside each container. The objects were either miniatures or small toys depicting objects in the real world. Objects were semantically grouped in each building. Thus, there were three distinct sets of objects and each set was related to the building that the objects were found in (i.e. the school building contained objects that were typically found in a school such as a map and a book). The hidden location of each object as well as the color and label of the building was consistent across children with all children seeing the red house, the yellow grocery store, and the blue school in that order.

Procedure

All children were shown the three buildings and asked to label them. Then children were told that they were going to play a "remember where it is" game and that they should try to remember what was in each of the rooms of the buildings. Children were told that for some of the rooms they would get to see the hidden object, but for the other rooms they would have to guess what was hidden from some clues or from a story about something that happened to the experimenter when she was a little girl. The clue condition contained 4 clues and the story condition contained a 4-phrase narrative beginning with 3 central details and ending with 1 peripheral detail associated with the target object. Central details were defined as details or actions necessary to understand the main plot or theme of the story (i.e. the character went to the park) whereas peripheral details were defined as descriptive details that were not central to the main plot of the story (i.e. the character had fluffy pink pillows on her couch) (Christianson & Loftus, 1987; Pillemer, 1998). Each narrative was an autobiographical event about something that had happened to the experimenter as a little girl and was written in the first person. The type of source cue that children received was randomized using a Latin square design so that an individual child only experienced 6 of each type of source (visual, clue, narrative episode), but across children each item was used at least once for each of the source types (see Appendix E)

If children appeared to understand the instructions, the researcher moved to the first building (the house) and pointed to the first room and labeled the source type for that room. In the visual condition the researcher pointed to the room and said, "for this room, I will show what is inside" and then opened the room and pulled out the object and showed it to child. If the child did not spontaneously label the object, the research asked "what is this" and if the child still did not respond or responded incorrectly, the researcher labeled the object and put it back in the room. In the clue condition the researcher pointed to the room and said " I can't show you what is in this room, but I will read you some clues about it." Then the researcher read the four clues and asked the child to state the name of the hidden object. If the child was correct the researcher confirmed the answer, if the child was incorrect, the researcher provided the correct response. In the narrative condition, the researcher pointed to the room and said "I can't show you what is in this room, but I will tell you about something that happened to me when I was little." Then the researcher read the child the narrative and ensured that the child heard the name of the object that was listed at the end of the narrative. This procedure was repeated for each room in the building and across all three buildings.

After learning what was hidden inside each of the buildings, children moved so they could no longer see the buildings and were asked to list any of the items that they could remember that were hidden in any of the three buildings. When children finished listing items they were prompted by the experimenter saying "can you remember anything else that was in the buildings?" until they indicated that they could not recall anything else. After this free recall task, all children were asked six developmentally appropriate trivia questions taken from the Brian Quest quiz games (Feder, 2005). This trivia game served as a distracter task only and the children's answers to these questions were not analyzed.

Following the distracter task, children were shown the buildings again and the researcher stated "now we are going to remember together what is in the rooms. I will point to the room and say what is inside, but if you know it you can say it, too." Then the researcher pointed to room number 1 in the first building and said "in this room there's a" the researcher then paused for approximately 3 seconds giving the child time to respond, if the child did not respond the researcher finished the statement and labeled the hidden object; e.g. "there's a key." Once either the child or the researcher had labeled what was in the room, the child was asked to indicate how he or she knew the location of the object. Specifically, the child was asked if they saw the object, if they guessed with some clues, or if the experimenter had told them about something that had happened to her when she was little. This procedure was repeated for all 3 buildings.

At the conclusion of the task, the researcher told the children that she wanted to go back to rooms where she had told them about something that had happened to her when she was little. Then the researcher went back to the first room with a narrative source and labeled the object in that room and told the child she had told them about something that happened to her when she was little and asked if they could remember anything about what she had told them. Children were encouraged to tell anything that they could remember, even if they could not remember everything the researcher said. This procedure was repeated for all 6 narrative source items (2 in each building).

Coding

All of the children's narrative responses were transcribed and coded for the number of correct and incorrect central and peripheral details.

Results

The total number of correct responses for the location of the hidden object as well as the source of the information during the delayed test were calculated for each participant.

Memory for location

A 2 (gender; male, female) x 2 (age; 4-5-year-old, 7-9-year-old) x 3 (source type; visual, clues, narrative) mixed factorial ANOVA was conducted on the number of correct locations with gender as an independent factor and source type as a repeated factor. Results indicated that there was a significant main effect for source, $F(2, 152) = 16.743$, $p<.001$ and for age, $F(1, 76) = 59.50$, $p<.001$. Pairwise comparisons indicated that the location of items were more likely to be recalled if they were presented via visual sources ($M = 1.30$, $SD = 1.29$) than either narratives ($M = .575$, $SD =.978$) or clues ($M = .525$, $SD = .897$) and that overall 4-5-year-old children ($M = .9750$, $SD = 1.14$) were significantly less likely to correctly recall the location of a hidden object than were 7-9-year-old children ($M = 3.825$, $SD =2.01$), regardless of the type of source. There was no significant effect of gender ($F(1, 76) = .165$, $p=.686$) or any significant interaction effects of age by gender ($F(1,76) = .293$, $p=.590$, age by source ($F(2, 152) = .501$, $p=.607$), gender by source ($F(2, 152) = .723$, $p= .487$, or age by gender by source ($F(2, 152) = .964$, $p= .384$).

Memory for source

A 2 (gender; male, female) x 2 (age; 4-5-year-old, 7-9-year-old) x 3 (source type; visual, clues, narrative) mixed factorial ANOVA was conducted on the number of correctly recalled sources. Similar to the results for memory for location, there was a significant main effect of both source, $F(2, 152) = 5.955$, $p=.003$ and age, $F(1, 76) = 45.648$, $p<.001$. Pairwise comparisons indicated that children were more likely to correctly identify visual ($M = 5.1125$, $SD = 1.18$) sources than narrative sources ($M = 4.34$, $SD = 1.68$), but that there was no difference in children's ability to correctly identify visual and clue sources ($M = 4.7250$, $SD = 1.59$). Pairwise comparisons for the two age groups indicated that 4-5-year-old children ($M = 12.425$, $SD = 2.44$) correctly identified fewer sources than 7-9-year-old children ($M = 15.925$, $SD = 2.13$) who were near ceiling in their identification of sources.

Responses in the free recall task

Table 10 summarizes children's performance in the free recall task. Children's correct recall of hidden items in the free recall task was analyzed using a 2 (gender; male, female) x 2 (age; 4-5-year-old, 7-9-year-old) x 3 (source type; visual, clues, narrative) mixed factorial ANOVA. There was a significant main effect of source $F(2, 152) = 39.526$, $p<.001$ with all children correctly recalling more objects that were presented via visual sources ($M= 2.63$, $SD = 1.24$) than either narrative ($M = 1.39$, $SD = 1.34$), or clue sources ($M = 1.15$, $SD =1.13$). There was also a significant main effect for age $F(1, 76) = 46.095$, $p<.001$, wherein 4-5-year-old children ($M = 3.6750$, $SD = 1.64$) recalled less in free recall than 7-9-year-old children ($M = 6.65$, $SD=2.20$). Additionally, there was a significant age by source interaction $F(2, 152) = 3.390$, $p =.036$. Visual inspection of the

Table 10. Average number (and standard deviation) of items correctly recalled in the free recall task for each source type.

	Males		Females	
	4-5 years	7-9 years	4-5 years	7-9 years
Visual	2.10(.72)	2.75(1.52)	2.60(1.10)	3.05(1.36)
Clue	.70(.80)	1.75(1.37)	.65(.75)	1.50(1.10)
Narrative	.65(.93)	2.15(1.42)	.65(.81)	2.10(1.25)

means indicated that while children in both age groups were most likely to recall items that they had seen, 7-9-year-old children were more likely to recall items that were presented via narratives than clues, but 4-5-year-old children were equally likely to recall items presented with either narrative or clues (see figure 2).

Recall of narrative episodes.

A series of 2 (gender; male, female) x 2 (age; 4-5-year-old, 7-9-year-old) x 3 (source type; visual, clues, narrative) mixed factorial ANOVAs were calculated for central, peripheral, and object details recalled as the dependent variables. Then an additional 2 (gender; male, female) x 2 (age; 4-5-year-old, 7-9-year-old) x 3 (source type; visual, clues, narrative) mixed factorial ANOVA was conducted for the combined total number of narrative details that children recalled. Table 11 lists the average number and types of details that children recalled.

Central details. There was a significant main effect for age, $F(1, 76) = 21.014$, $p<.001$ with 4-5-year-old children recalling significantly fewer central narrative details than did 7-9-year-old children. There were no significant gender differences, $F(1, 76) = .023$, $p=.879$ or age by gender interaction, $F(1, 76) = .584$, $p=.447$.

Peripheral details. There was a significant age effect for the number of peripheral details recalled, $F(1,76) = 18.907$, $p<.001$. There were no significant gender, $F(1, 76) = .992$, $p=.322$ differences for the number of peripheral details recalled. Also, there were no significant gender by age interaction, $F(1, 76) = .984$, $p=.324$.

Object details. Similar to children's recall of central, there was a significant age difference in children's recall of object details, $F(1,76) =23.036$, $p<.001$, with 4-5-year-old children recalling fewer object details than 7-9-year-old children. However, there

Figure 2. Average number of items presented with each source type that were correctly recalled in the free recall task.

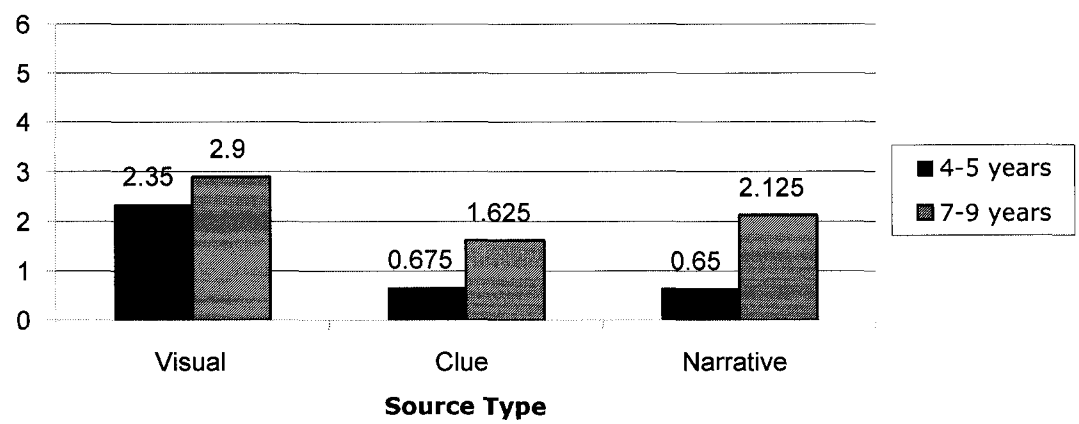


Table 11. Average umber (and standard deviation) of details correctly recalled for the narrative sources.

	Males		Females	
	4-5 years	7-9 years	4-5 years	7-9 years
Central[a]	2.55(2.33)	5.05(2.93)	2.15(2.25)	5.65(3.90)
Peripheral[a]	.30(.47)	1.05(1.19)	.20(.52)	1.20(1.15)
Object[a,b]	1.55(1.15)	2.40(1.50)	1.20(1.20)	3.10(1.25)
Total[a]	4.40(3.35)	8.50(4.97)	3.55(3.49)	9.95(5.39)

[a] 7-9-years>4-5-years, $p \leq .05$
[b] age by gender interaction, $p \leq .10$

were no significant gender differences, $F(1, 76) = .373$, $p=.543$. There was a marginally significant age x gender interaction, $F(1, 76) = 3.358$, $p=.071$. Inspection of the means indicates that the difference between 4-5-year-old and 7-9-year-old girls was greater than the difference between 4-5-year-old and 7-9-year-old boys.

Total details. Analysis of the central, peripheral, and object details (the total number of narrative details), indicated that there were significant age difference in children's recall, $F(1, 76) = 28.584$, $p<.001$. As was seen with both central and object details, 4-5-year-old children recalled fewer details of the narrative than did 7-9-year-old children. There was no significant effect of gender, $F(1,76) = .093$, $p=.761$ or age by gender interaction, $F(1,76) = 1.371$, $p=.245$.

There was also a significant positive correlation between the number of total details recalled and the number of narrative sources labeled correctly for 7-9-year-olds ($r=.349$, $p=.027$) but not for 4-5-year-olds ($r=.127$, $p=.435$). This indicates that for children in the older age group recall of the narrative details were associated with recalling that the source itself was a narrative, but for children in the younger group recalling the narrative details does not appear to be related to correctly recognizing that they were associated with a narrative source.

Relationship experiment one

To determine whether children's performance on the source monitoring task was predictive of their use of episodic memories on experiment 1, a series of correlations between the two tasks were conducted. The results of these analyses indicated that there was a significant positive relationship between the number of memories that children reported in experiment 1 and the number of free recall items that were presented via narrative sources in the source monitoring task. This was true for both genders (girls $r = .334$, $p= .035$, boys $r= .522$, $p=.001$) and age groups (4-5-year-olds $r= .318$, $p=.045$, 7-9-year-olds r= . .334, $p=.035$). The fact that children who recalled more of the items that were presented via narrative sources also reported recalling more learning episodes indicates that children who recall many episodes retrospectively may be doing so because these episodes were actually helpful to them in the learning process, not just in recall.

There was also a significant positive correlation between the number of details girls recalled from the narrative sources in the source monitoring task and both the number of episodes ($r=.393$, $p=.012$) and the average number of adjectives and adverbs ($r=.392$, $p=.026$) they reported. Thus, girls of both age groups who recalled more of the details from the narratives presented in the source monitoring task were likely to report more episodes and use more details in those episodes.

Discussion

Congruent with the source monitoring literature (Gopnik & Graf, 1988; Leichtman, Morse, et al., 2000; Taylor et al., 1994) younger children had greater difficulty identifying the source of information about the hidden object whereas older children were near ceiling in the identification of sources. However, regardless of age, all children had the greatest difficulty distinguishing between cue and narrative source types. This could be due to the similarities between these types of sources in that both were spoken by the experimenter and contained no visual cues. Thus, in order to correctly distinguish between these sources children had to not only reason if they had seen the object or heard about it, but they also had to further reason about what they heard and this dual level reasoning made cue and narrative distinctions particularly difficult.

Contrary to the hypothesis of the study, there were no significant gender differences in the ability to correctly identify any of the source types, that is both genders were equally able to use the available cues to correctly identify a source. This could indicate that source monitoring may not be a sufficient explanation for why girls and women report more memories for classroom episodes as was seen in the study by Leichtman et al. (2007) as well as pilot study 1. However, this conclusion may be premature in that children in the older age group were at ceiling in their performance making gender differences undetectable in this large portion of the sample. Also, because the task was a traditional source monitoring paradigm, it only involved children's short term recall of relevant source cues. Thus, because the classroom demands long term recall of source cues (i.e. the cues surrounding the learning episode) the short term interval may not have accurately approximated the demands on children's source monitoring that are present in their classrooms.

In contrast to children's performance on the source identification portion of the task, both groups were well below ceiling on both the memory for the location of the object and their free recall of the object. Children were more likely to recall both the location and the identity of the object when they actually saw the miniature object. As mentioned previously, this is likely due to the fact that the visual condition was much more salient to children than were the other two source conditions, making item presented visually much more memorable for children of both age groups. However, when looking at children's performance in the free recall task, there were significant differences in how different age groups benefited from the clue and narrative source types. Whereas younger children were equally likely to recall an object regardless of whether it was presented with a clue or a narrative, older children showed more accurate recall if the item was presented with a narrative. This is congruent with the research by Herbert and Burt (2004) in which college students were more likely to recall material presented via narrative rich content and that over time they more likely to add narrative rich material to their semantic memory store (i.e. building a general knowledge base). However, unlike in Herbert and Burt's (2004) study where the factual information in the narrative rich and narrative poor conditions did not differ, the amount of factual information in the clue and narrative conditions in the present study were not equal. In fact, children received more information about the target object in the clue condition whereas the narrative condition, although balanced to the clue condition in regards to number of phrases, contained more contextual information that was not directly related to the identity of the object. Thus, the findings of the present study highlight the benefits of contextual details in older children's recall of material.

It is possible that older children were more likely to benefit from narrative sources because they were more likely to recall the details of these sources. Indeed, older children did recall more of the narratives than did younger children. However, the number of details that older children recalled was positively correlated with the number of narrative sources they correctly identified, but this relationship was not found in younger children. This indicates both that younger children recalled fewer details and fewer narrative sources, but it also indicates that they did not make a connection between the details of the narrative and the fact that those same details could help them recall the source of information. Thus, as Leichtman, Morse, et al. (2000), Taylor et al. (1994), and Poole and Lindsay (2002) have indicated, children under the age of 5-7 years, are less likely to recognize the connection between a source and a piece of target information and thus may not benefit from any degree of contextual source information (Pearse et al., 2003). In contrast, children age seven and older do make the connection between target material and its source and thus can benefit from rich contextual information, making the narrative sources in the present study particularly beneficial to them.

CHAPTER VII

GENERAL DISCUSSION

The purpose of the proposed to studies was to investigate gender and developmental differences in the use of episodic memories and to offer insight into how a more episodic style contributes to gender differences on standardized aptitude tests. There were significant gender differences in the proportion of episodes that girls reported for answers that they knew and that they got correct. There were also differences in the types of memories children of each gender reported. In both pilot study 2 and experiment 1, girls reported memories that were longer and contained more mentions of relationships and non-specific others. Also, girls in both samples gave more embellished narratives, illustrated in the greater number of adjective and adverbs that girls in experiment 1 reported and the greater amount of direct and indirect speech that girls in pilot study 2 reported. This detailed of style of reporting has been shown in interview (Pillemer et al., 2003; Buckner & Fivush, 1998) and social contexts as well (Leichtman et al., 2008). The fact that girls also offer a more detailed recall of specific episodes that influenced their learning is consistent with the notion that girls are more detail oriented when they reconstruct memories of previously learned material and that this attention to detail emerges as early as 4 years of age. Further, not only did girls report more detail in their own narratives, but the number of details of the narrative sources that girls, but not boys, reported recalling in the source monitoring task was positively correlated with the number of adjectives and adverbs that they reported in their own narratives in experiment one. This indicates a global preference for detail both in learning novel material and in recalling past material. This finding is congruent with the research on parent-child memory conversations in which parents model a more elaborative, detail-focused recall style with their daughters (Reese & Fivush, 1993). This is significant because these early parent-child memory conversations are important in developing children's ability to report a past episode independently. Through these conversations children learn both the structure for retelling a past event and the details to include in the narrative (Fivush & Fromhoff, 1988; Leichtman, Pillemer, et al., 2000; Reese et al., 1993; Reese & Fivush, 1993). Thus, if parents are more detail focused with girls, they are implicitly instructing them to be more detailed in their recall of past events, perhaps establishing an early preference for a more episodic recall style where girls are more focused on telling the whole event rather than just its key target facts.

A detailed, episodic-based recall style is useful in learning in that it increases the likelihood that a piece of information will eventually enter into a general knowledge base (Conway et al., 1997) and allows for a richer encoding of the material (Herbert & Burt, 2004). Episodic recall may also be useful in that it allows children to engage in a corrective process when recalling target material and may alert them if they are recalling the target fact incorrectly. For example, one girl in the third grade sample reasoned that if it was 2:00 in her state then it would also be two o'clock in Delaware, even though it would be reasonable to assume that the different states may have different times, by recalling the context in which she learned about the time zones. She said, "Um.. we..we were looking at the Eastern Time zone the same day we learned about the Central Time zone and I know that uh my state is in the Eastern Time zone and so is Delaware so I knew that it would be the same time." Even when answering general knowledge questions that are less bound to classroom episodes, some children still used episodic memories to help them eliminate possible answer choices. For example one 9-year-old used a specific episode to eliminate Sacagawea as a possible answer choice to a question about who had helped to free the slaves. He said, "I knew the answer because I had read about.... I had seen in a movie Sacagawea but then I remembered that she was helping Lewis and Clark so it must have been the other one." In both of these instances, the episodes that the children provided were just as useful in helping them to correct flaws in their thinking as they were to leading them to the correct answer.

While this self-corrective process implicit in recalling the details of learning episodes may be quite useful to students when recalling classroom material or even recently acquired knowledge, it may not be as useful in recalling information that is part of a larger store of general knowledge. This is due to the fact that recalling particular episodes is both time consuming and is dependent upon the material being located in a particular learning context (i.e. it must be able to be clearly connected to a particular environment). While classroom tests may encourage the use of episodic recall in that students are tested on material that bears some similarity to the way in which they were taught the material, standardized aptitude tests are designed to be acontextual so that students must demonstrate a generalization of skills beyond their learning environment to answer the question correctly. Therefore, the fact that girls are showing preference for the detail associated with an episodic recall strategy from an earlier age, may lead them to uniformly adopt this as a recall strategy across testing situations in adolescence which in turn leads them to succeed in the classroom, but fail on standardized tests.

Girls' early preference for an episodic recall style may also explain why, by adolescence, girls show less interest in taking courses in math and science and are less likely to pursue careers in these areas (Simpkins et al., 2006; Hong& Xing, 1997). Math and science material does not readily lend itself to the same narrative style as do other subject areas. This is due to the fact that the material presented in math and science courses centers around learning a fact or formula whereas in other subject areas, such as social studies or literature, the material is centered around learning about a particular event. Thus, narrative recall is central to acquiring knowledge in these domains, but in math and science it is not necessary. Since girls are demonstrating a preference for reporting more embellished narratives about past learning events from an early age, it is likely that they will perform better in course that provide them with an opportunity to learn from detailed narratives, an opportunity that is not naturally present in math and science courses.

While it is possible that girls may have a natural preference for detail rich narratives, it does not appear that a more episodic based recall style is reflective of inherent differences in source monitoring ability that underlie recall. In fact, both genders performed very similarly in the source monitoring task in experiment 2, both in their correct labeling of sources and in their free recall performance. This indicates that when both boys and girls are presented with detail-rich narratives in a controlled experimental context they are equally able to label the source of the information and to use the narratives details to facilitate their recall of the a target piece of information. This stands in contrast, to children's own reports of their learning (i.e. experiment 1 and pilot study 2) where girls' narratives are more detailed. Thus, it appears that when children are in a more natural learning environment where they can encode different types of information for the same target material, girls appear to be more likely than boys to encode narrative detail, but when the learning environment is tightly controlled and there is only one source of information, as in experiment 2, girls and boys are equally able to use and recall narrative sources. Taken together, this indicates that gender differences in episodic memory may not be the result of differences in underlying cognitive mechanisms, but rather that they are the result of gender differences in preference for narrative detail, with girls being socialized very early in their development to focus on such details (Nelson & Fivush, 2004). One limitation to this conclusion, as mentioned previously, is that children in the 7-9-year-old group performed near ceiling in the source monitoring aspect of the task, and their ceiling performance could be masking potential differences.

While there were no gender differences in children's source monitoring ability, there were significant developmental differences. As predicted, children in the younger age group reported fewer narratives in experiment 1 and were less likely to correctly recall the source of the item or the item in experiment 2. This is congruent with past research on children's episodic memory development (Bauer, 2004, 2007; Hamond & Fivush, 1991; Pillemer, 1998) as well as their emerging source monitoring skills (Gopnik & Graf, 1988; Leichtman, Morse et al., 2000; Foley & Johsnon, 1989; Pearse et al., 2003; Poole & Lindsay, 2002; Bright-Paul et al., 2005). However, even with the modest amount of scaffolding provided for children's narratives in experiment 1 compared with the amount of scaffolding that children are often provided by their parents in memory conversations (e.g. Reese & Fivush, 1993; Leichtman, Pillemer, et al., 2000), even the youngest children were able to provide narratives, that if not completely specific, were consistent with descriptions of specific moments. This indicates that children in this preschool age group are at an intermediate stage in developing the independent recall skills that would be necessary for them to not only report, but to use episodic memories as effective learning tools.

However, in contrast to the findings of Taylor et al. (1994, experiments 1 and 2) children in this sample were capable of indicating that they had learned a piece of information at a particular moment; that is, children recognized that there was a period of time where they did not know a piece of information. There are two main reasons why children in this sample appear to be more adept at identifying learning events. The first is that children in this sample were explicitly taught the difference between "remembering the moment" and "not remembering the moment" one learned a fact in the training task and were excluded if they could not comprehend these instructions. Thus, children in this sample were made explicitly aware that they were talking about learning and specific times that learning might occur. This awareness does have an effect of children's ability to correctly identify the source of their knowledge. In fact, Taylor et al. (1994) found in experiments 3 and 4 of their study that just telling children they were going to learn something new enhanced their performance, and it is likely that the more detailed training of the present study served to enhance children's performance even further. A second reason for children's apparently heightened awareness of their own learning in experiment 1, is that unlike in the staged learning events that Taylor et al. (1994) used, it was impossible to determine the veracity of children's accounts in the present study. Anecdotally, it was noted that several children reported learning something as infants or toddlers, indicating that their reports may not be factually accurate, even if they themselves believe them to be true. Further research is needed to investigate the accuracy of young children's learning episodes and to what extent children combine accurate facts with inaccurate embellishment to explain their own learning, even as they are developing their metamemory skills.

Perhaps due to emerging metamemory skills, children in the younger age group, were not able to use narrative sources as effectively as older children, as was clearly seen in experiment 2. In fact, while older children were more likely to remember hidden objects that were presented with narrative versus clue sources, younger children were equally likely to remember items presented via these two sources. The reason for this lack of sensitivity to narrative cues could be that children of this age do not readily connect material with its source (Leichtman, Morse, et al., 2000; Poole & Lindsay, 2002) and thus cannot fully appreciate the contextual details that narratives provide. Further, it is likely that the same narrative details that facilitated recall in older children were distracting to younger children, who had greater difficulty extracting the identity of the hidden object from the narrative. However, although younger children were less likely to recall items that were learned via narrative sources, just as was seen in the older children, the number of item presented via narrative sources in the source monitoring task in experiment 2 was positively correlated with the number of episodes they reported in experiment 1. This indicates that across age groups there was a relationship between remembering a past learning episode and using an episode as a source of information. Future research should focus on how children come to recognize narratives as important sources of information and why narrative sources proved to be particularly useful to the 7-9-year-old children in the present sample.

The present studies were designed to investigate when gender differences in episodic memory emerge in development and to investigate the role of source monitoring in these gender and developmental differences. The findings from experiments 1 and 2, and pilot study 1 and 2 indicate that gender differences in episodic memory, though largely present in adolescent and young adult populations, are only starting to emerge in young children. One early indicator of these gender differences is the increased level of embellishment that girls provide in their narratives. However, contrary to preliminary hypotheses, the results of experiment 2 indicate that source monitoring is not the mechanism by which gender differences emerge, although further research is needed to rule out this possibility.

Regarding developmental differences, the young children in the present study appeared to be particularly adept at recognizing and describing learning events, although as expected, they did not perform at the same level as the older children. Further, when presented with narrative sources, younger children were less likely to benefit from these sources than were older children. This indicates that between the ages of 5 and 7 years, children's ability to not only report learning narratives, but to also to learn from narrative sources increases.

While the present studies focused on children's retrospective use of narratives in their natural learning environments as well as their on-line use of narratives in a controlled task, future research should attempt to combine the methods used in these tasks to create a situation where children are presented with or naturally offer narrative material as part of their daily classroom activity. Such a study could offer insight into how teachers could create developmentally appropriate curricula to enhance children's long term retention of material as well as potentially increasing interest amongst girls in less naturally narrative based subjects, such as math and science.

LIST OF REFERENCES

Bauer, P. (2004). Early memory development. In U. Goswami (Ed.) *Blackwell Handbook of Childhood Cognitive Development* (pp. 127-146). New York: Wiley.

Bauer, P. (2007). *Remembering the times of our lives: Memory in infancy and beyond.* Mahwah, NJ: Erlbaum.

Boman, E. (2004). The effects of noise and gender of children's episodic and semantic memory. *Scandinavian Journal of Psychology, 45*, 407-416.

Bright-Paul, A., Jarrold, C., & Wright, D.B. (2005). Age appropriate cues facilitate source-monitoring and reduce suggestibility in 3- to 7-year-olds. *Cognitive Development, 20*, 1-18.

Buckner, J.P. & Fivush, R. (1998). Gender and self in children's autobiographical narratives. *Applied Cognitive Psychology, 12*, 407-429.

Byrnes, J.P., Hong, L., & Xing, S. (1997). Gender differences on the math subtest of the Scholastic Aptitude Test may be culture specific. *Educational Studies in Mathematics, 34*, 49-66.

Cahill, L. & van Stegeren, A. (2003). Sex-related impairment of memory for emotional events with β-adrenergic blockade. *Neurobiology of Learning and Memory, 79*, 81-88.

Castambis, S. (1995). Gender, race, ethnicity, and science education in the middle grades. *Journal of Research in Science Teaching, 32*, 243-257.

Ceci, S.J., Crotteau Huffman, M.L., Smith, E., & Loftus, E. (1994). Repeatedly thinking about a non-event: Source misattributions among preschoolers. *Consciousness and Cognition, 3*, 388-407.

Ceci, S.J., Loftus, E.F., Leichtman, M.D., & Bruck, M. (1994). The possible role of source misattributions in the creation of false beliefs among preschoolers. *International Journal of Clinical and Experimental Hypnosis, 62*, 304-320.

Christianson, S-A. & Loftus, E. F. (1987)Memory for traumatic events. *Applied Cognitive Psychology, 1*, 225-239.

Cloud, J. (2006, September 3). How I did on the SAT. *Time*. Retrieved February 3, 2007, from http://www.time.com

Conway, M.A., Gardiner, J.M., Perfect, T.J., Anderson, S.J., & Cohen, G.M. (1997). Change in memory awareness during learning: The acquisition of knowledge by psychology undergraduates. *Journal of Experimental Psychology: General, 126*, 393-413.

Ely. R., Gleason, J.B., McCabe, A. (1996). Why didn't you talk to your mommy, honey?': Parents' and children's talk about talk. *Research on Language and Social Interaction*, *29*, 7-25.

Feder, C.W. (2005). *Brain Quest, Revised 3rd Edition.* New York, NY: Workman Publishing.

Fivush, R. & Buckner, J.P. (2003). Constructing gender and identity though autobiographical narratives. In R. Fivush & C. Haden (Eds.), *Autobiographical memory and the construction of a narrative self: Developmental and cultural perspectives* (pp. 149-168). Hillsdale, NJ: Erlbaum.

Fivush, R. & Fromhoff, F.A. (1988). Style and structure in mother-child conversations about the past. *Discourse Processes, 11*, 337-355.

Fivush, R. & Nelson, K, (2006). Parent-child reminiscing locates the self in the past. *British Journal of Developmental Psychology*, *24*, 235-251.

Foley, M.A. & Johnson, M.K. (1985). Confusions between memories for performed and imagined actions: A developmental comparison. *Child Development*, *56*, 1145-1155.

Goddard, L., Dritschel. B., & Burton, A. (1998). Gender differences in the dual-task effects on autobiographical memory retrieval during social problem solving. *British Journal of Psychology*, *89*, 611-627.

Gopnik, A. & Graf, P. (1988). Knowing how you know: Young children's ability to identify and remember the sources of their beliefs. *Child Development*, *59*, 166-1371.

Hamond, N.R. & Fivush, R.(1991) Memories of Mickey Mouse: Young children recount their trip to Disneyworld. *Cognitive Development*, *6*, 433-448.

Herbert, D.M.B. & Burt, J.S. (2004). What do students remember? Episodic memory and the development of schematization. *Applied Cognitive Psychology*, *18*, 77-88.

Herlitz, A. & Yonker, J.E. (2002). Sex differences in episodic memory: The influence of intelligence. *Journal of Clinical and Experimental Neuropsychology*, *24*, 107-114.

Hudson, J.A. (1990). The emergence of autobiographical memories. In R. Fivush and J.A. Hudson (Eds.). *Knowing and remembering in young children* (pp.166-196). Cambridge, MA: Cambridge University Press.

Hyde, J.S., Fennema, E., & Lamon, S.j. (1990). Gender differences in mathematics performance: A meta-analysis. *Psychological Bulletin, 107*, 139-155.

Johnson, M.K., Hashtroudi, S., & Lindsay, D.S. (1993). Source monitoring. *Psychological Bulletin, 114*, 3-28.

Kenney-Benson, G.A., Pomerantz, E.M., Ryan, A.M., & Patrick, H. (2006). Sex differences in math performance: The role of children's approach to schoolwork. *Developmental Psychology*, 42, 11-26.

Leahey, E. & Guo, G. (2001). Gender differences in mathematical trajectories. *Social Forces, 80*, 713-732.

Leichtman, M.D., Morse, M. B., Dixon, A., & Spiegel, R. (2000). Source monitoring and Suggestibility: An individual differences approach. In K.P. Roberts & M. Blades (Eds.), *Children's source monitoring* (pp. 257-287). Mahwah, NJ: Erlbaum.

Leichtman, M.D., Pillemer, D.B., Liu, L.S., & Embree, S.L. (2008). *Gender differences in early adolescents' memory sharing during natural conversation.* Manuscript in preparation.

Leichtman, M.D., Pillemer, D.B., Wang, Q., Koreishi, A. & Han, J.J. (2000). When baby maisy came to school mothers' interview styles and preschoolers event memories. *Cognitive Development, 15*, 99-114.

Leichtman, M.D., Pillemer, D.B., Comley, L., Vigliatura, K., & Skowronek, J.S. (2007, March). *Gender differences in episodic memory in the middle-school classroom.* Poster session presented at the annual meeting of the Society for Research on Child Development, Boston, MA.

Lewin, C., Wolger, G., & Herlitz, A. (2001). Sex differences favoring women in verbal but not in visuospatial episodic memory. *Neuropsychology, 15*, 165-173.

Lockl, K. & Schneider, W. (2007). Knowledge about the mind: Links between theory of mind and later metamemory. *Child Development, 78*, 148-167.

McCabe, A. & Peterson, C. (1991). Getting the story: A longitudinal study of parental styles in eliciting narratives and developing narrative skill. In A. McCabe & C. Peterson (Eds.), *Developing Narrative Structure* (pp. 217-253). Hillsdale, NJ: Erlbaum.

Nelson, K. & Fivush, R. (2004). The emergence of autobiographical memory: A social cultural developmental theory. *Psychological Review, 111*, 486-511.

Nuthall, G. (1999). The way students learn: Acquiring knowledge from an integrated science and social studies unit. *Elementary School Journal*, *99*, 303-341.

Nuthall, G. & Alton-Lee, A. (1990). Research on teaching and learning: Thirty years of change. *Elementary School Journal*, *90*, 547-570.

Nuthall, G. & Alton-Lee, A. (1995). Assessing classroom learning: How students use their knowledge and experience to answer classroom achievement test questions in science and social studies. *American Educational Research Journal*, *32*, 185-223.

Ornstein, P.A. & Haden, C.A. (2001). Memory development of the development of memory? *Current Directions in Psychological Science*, *10*, 202-205.

Pillemer, D.B. (1998). *Momentous events, vivid memories*. Cambridge, MA: Harvard.

Pillemer, D.B., Goldsmith, L.R., Panter, A.T., & White, S.H. (1988). Very long-term memories of the first year in college. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *14*, 709-715.

Pillemer, D.B., Wink, P., DiDonato, T., & Sanborn, R.L. (2003). Gender differences in autobiographical memory styles of older adults. *Memory*, *11*, 525-532.

Pearse, S.L., Powell, M.B., & Thompson, D.M. (2003). The effect of contextual cues on children's ability to remember an occurrence of a repeated event. *Legal and Criminological Psychology*, *8*, 39-50.

Pomerantz, E.M., Altermatt, E.R., & Saxon, J.L. (2002) Making the grade but feeling distressed: Gender differences in academic performance and internal distress. *Journal of Educational Psychology*, *94*, 396-404.

Poole, D.A. & Lindsay, D.S. (2002). Reducing child witnesses' false reports of misinformation from parents. *Journal of Experimental Child Psychology*, *81*, 117-140.

Reese, E. & Fivush, R. (1993). Parental styles of talking about the past. *Developmental Psychology*, *29*, 596-606.

Reese, E., Haden, C.A., & Fivush, R. (1993). Mother-child conversations about the past: relationships of style and memory over time. *Cognitive Development*, *8*, 403-430.

Roberts, K. P. (2002). Children ability to distinguish between memories from multiple sources: implications for the quality and accuracy of eyewitness statements. *Developmental Review*, *22*, 403-435.

Ross, M. & Holmberg, D. (1992). Are wives' memories for events in relationships more vivid than their husbands' memories? *Journal of Personality and Social Psychology*, *9*, 585-604.

Ryan, K.E. & Ryan, A.M. (2005). Psychological processes underlying stereotype threat and standardized math test performance. *Educational Psychologist*, *40*, 53-63.

Simpkins, S.D., Davis-Kean, P.E., & Eccles, J.S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology*, *42*, 70-83.

Steele, J.R. & Ambady, N. (2006). "Math is hard!" The effect of gender priming on women's attitudes. *Journal of Experimental Social Psychology*, *42*, 428-436.

Taylor, M., Esbensen, B.M. & Bennet, R.T. (1994). Children's understanding of knowledge acquisition: The tendency for children to report they have always known what they have just learned. *Child Development*, *65*, 1581-1604.

Thierry, K.L, Goh, C.L., Pipe, M-E., & Murray, J. (2004). Source recall enhances children's discrimination of seen and hear events. *Journal of Experimental Psychology: Applied*, *11*, 33-44.

Thierry, K.L., Spence, M.J., & Memon, A. (2001). Before misinformation is encountered: Source monitoring decreases child witness suggestibility. *Journal of Cognition and Development*, *2*, 1-26.

APPENDICES

APPENDIX A

The questionnaire with the instructions used in pilot study 1 are presented in appendix A.

We are researchers at the University of New Hampshire studying how students remember information when answering questions on tests.

We would like to invite you to fill out the following questionnaire. You are under no obligation to do so. Your professor will not see the answers to the questionnaire and your answers will have no effect on your grade.

Rhyannon Bemis, Graduate Student in Psyhcology
Michelle Leichtman, Associate Professor of Psychology
David B. Pillemer, Samuel E. Paul Chair in Developmental Psychology

If you have questions about your rights as a human subject, you may contact Julie Simpson, Regulatory Compliance Officer at 603-862-2003 or Julie.simpson@unh.edu

Please do not write your name on the questionnaire

This questionnaire will ask you to look again at some of the questions on the test you just took and to tell us how you figured out the answers. You will be given the actual question as it appeared on you exam. Please answer the questions carefully. For each question you will complete the following steps:

1. Look at each question and tell us the answer you gave on the exam. This will be a-d on the multiple choice and your written answer on the short answer questions. Please note, we would like you tell us which answer you chose while taking the exam NOT the answer that you think may be correct now after having taken the exam.

2. Tell us how you figured out the answer to each question while you were taking the exam. Choose ONE of the following options:

   A. I remembered a specific moment when I learned the information that helped me answer the question.

   This option includes, for example, remembering a specific moment in the lecture when you learned this information, a specific moment when you read the information in your textbook or a specific moment when you learned the information as part of a group study session or outside of class. If you choose this option please tell us everything you can remember about the circumstances during the moment you learned the material in the space provided, for example you might write something like:

   " I was sitting in class and the professor showed a giant slide with the food pyramid on it, with grains in yellow. I remembered seeing bread at the yellow part and the professor said that because this was the biggest part of the pyramid we needed the most of it in our diet."

   B. I "just remembered" the answer, but didn't remember a specific moment when I learned it.

   This option includes knowing the answer, but not recalling a particular moment where you learned the information. In this option you "just knew" the answer, but you do not remember the moment you learned it.

   C. I guessed the answer

   This option includes answers for which you guessed or used the process of elimination to arrive at the answer. In this case, you did not answer by "just knowing" or by recalling a specific moment.

   D. Other

   This option included any other ways (not included in the preceding options) in which you may have figured out the answer. If you choose this option
   please describe how you came to your answer in the space provided.

AGE______ YEAR at UNH_______ GENDER______ Cumulative GPA_____

Time of Lecture (please circle one): 8:10 a.m 9:40 a.m. 11:10 a.m.

Question 47

True or False? Free radical damage occurs only in the hydrophilic portions of the body.

A. True

B. False

WHICH ANSWER DID YOU CHOOSE? _______

WHY DID YOU CHOOSE THIS ANSWER? (circle one)

A. I remembered a specific moment when I learned the information that helped me answer the question.

Please tell us everything you can remember about this moment.

____

____

____

____

B. I "just remembered" the answer, but didn't remember a specific moment when I learned it.

C. I guessed the answer.

D. Other (please explain).

____

____

____

____

APPENDIX B

The questions used in experiment 1 are presented in appendix B. Participants only completed the questions that corresponded to their age group.

Social Studies

Leaving Early Preschool (Age 4) (Brain Quest for Threes)
1. What machine is this. (**A computer**)

2.What do you say when you answer the phone? (**Hello**)

Leaving/Early Kindergarten (Preschool Brain Quest)
1. What's the polite thing to say when someone gives you a gift. (**Thank You**)
2. What type of food do most people eat on Thanksgiving day, Turkey or Pizza? (**Turkey**)

Leaving 1st Grade (Kindergarten Brain Quest)
1.He works in a bakery. What is he called? (**A baker**)
2. What's the opposite of hot? (**Cold**)

Leaving 2nd Grade (1st Grade Brain Quest)
1. Who was the first president of the United States? (**George Washington**)
2. Is Asia a country or a continent? (**a continent**)

Leaving 3rd Grade (2nd Grade Brain Quest)
1. Is the United States a country or a continent? (**A Country**)
2. She helped hundreds of slaves to escape. Was her name Sacagawea or Harriet Tubman? (**Harriet Tubman**)

Leaving 4th Grade (3rd Grade Brain Quest)
1. What is the name of our nation's capital? (**Washington, D.C.**)
2. True or False. More than one U.S. president was named Roosevelt. (**True**)

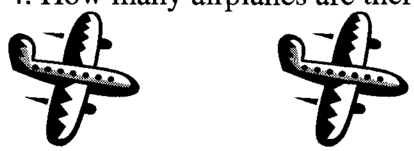
Leaving 5th Grade (4th Grade Brain Quest)
1. What two countries share Niagara Falls? (**U.S.A. and Canada**)
2. Who was the main writer of the declaration of independence? (**Thomas Jefferson**)

Math

Leaving Early Preschool (Age 4) (Brain Quest for Threes)
3. Which one looks like a square.

○ △ □

4. How many airplanes are there?



Leaving Preschool/Early Kindergarten (Brain Quest for Preschool)
3. What number is this.

8

4. What number comes right after 4?

Leaving 1^{st} Grade (Brain Quest Kindergarten)
3. How many pennies make one dime?
4. What number is between 4 and 6?

Leaving 2^{nd} Grade (1^{st} Grade Brain Quest)
3.What kind of number is seven odd or even? (**Odd**)
4. How many minutes in an hour? (**60**)

Leaving 3^{rd} Grade (2^{nd} Grade Brain Quest)
3. How many quarters equals one dollar? (**4**)
4. It's 12:15. What time will it be in 1 hour? (**1:15**)

Leaving 4^{th} Grade (3^{rd} Grade Brain Quest)
3. Which digit is in the tens place in the number 175 (**7**)
4. How many sides does a pentagon have? (**5**)

Leaving 5^{th} Grade (4^{th} Grade Brain Quest)
3. What is shorter a radius or a diameter? (Radius)
4. If its two minutes after midnight is it 12:02 p.m. or 12:02 a.m.?

Science

Leaving Early Preschool (Age 4) (Brain Quest for Threes)
5. What comes out of a chimney? (**Smoke**)
6. I go oink. I live in a sty what am I (**A Pig**)

Leaving Kindergarten/ Early Kindergarten (Brain Quest for Preschool)
5. What do hens lay? (**Eggs**)
6. What do you see in the sky at night, the moon or the sun? (**Moon**)

Leaving 1st Grade (Brain Quest for Kindergarten)
5. What melts on a hot day, an ice cube or an apple. (**Ice Cube**)
6. Which animal can live in the desert, a camel or a moose. (**Camel**)

Leaving 2nd Grade (1st Grade Brain Quest)
5. Name the part of a plant that you plant in the ground. (**a seed**)
6. Which can change into a moth: a caterpillar or a tadpole? (**a caterpillar**)

Leaving 3rd Grade (2nd Grade Brain Quest)
5. What kind of desert plant has sharp spines instead of leaves. (**A Cactus**)
6. Which will turn into a butterfly: a worm or a caterpillar? (**A Caterpillar**)

Leaving 4th Grade (3rd Grade Brain Quest)
5. Atoms are particles of matter. Are they very large or very small (**Small**)
6. What flows out of a volcano when it erupts? (**Lava or Magma**)

Leaving 5th Grade (4th Grade Brain Quest)
5. Which will dissolve in water: salt, sand, or gravel? (**Salt**)
6. Does electricity move through a conductor or an insulator? (**A Conductor**)

APPENDIX C

The structured interview for experiment 1 and pilot study 2 are presented in appendix C.

Now I want to ask you about some questions that you may have learned. .I want you to try to tell me how you knew the answer to the questions. Sometimes when people answer questions, they remember the exact moment when they learned the answer to the question So they might remember that they were sitting at their Kitchen table, or that their teacher told them the answer, or maybe they remember reading it in a book one afternoon. All of these things mean they remember the exact moment when they learned the answer.

Sometimes when people answer questions, they don't remember the moment when they learned, but they are sure they know the answer. This means that they just know the answer but they don't remember when they learned it.

Now, I will give you two examples for practice and I want you to tell me whether they would mean that the person remembered the exact moment when they learned the answer or that they don't remember when they learned it.

A person is trying to answer the question 2 + 2, he/she remembers the answer because one night he/she was doing his/her homework at the kitchen table and his/her mom helped him/her to draw a picture showing 2 +2 = 4. Would this mean that he/she remembered the moment when he/she learned the answer or that he/she didn't remember when he/she learned the answer.

A person is trying to answer the question 1+1, he/she knows he/she knows the answer and has seen the question before but he/she doesn't know where. Would this mean that he/she remembered the moment when he/she learned the answer or that he/she didn't remember when he/she learned the answer.

So, now I am going to read you some of your questions. I want you to do just like we practiced and tell me if you remember the moment when you learned the answer or if you don't.

Question 1: READ QUESTION AND ANSWER GIVEN

Did you know the answer or did you guess?

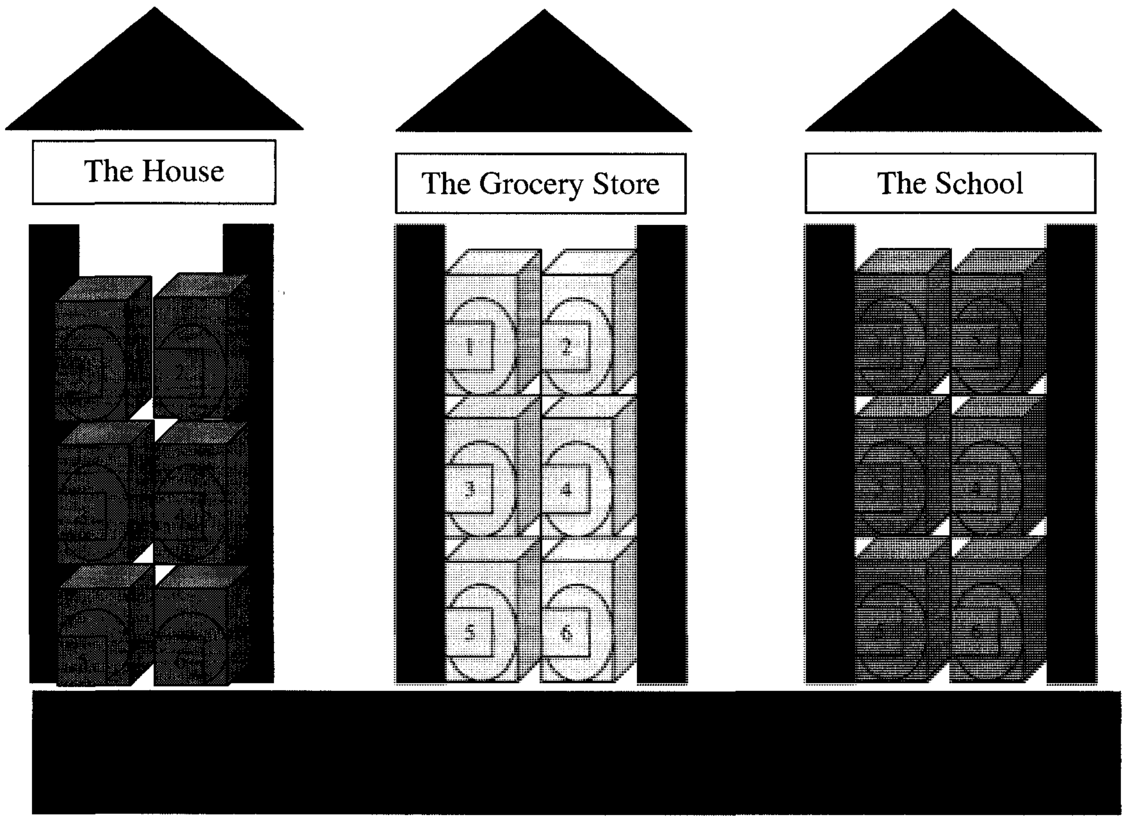
Did you remember the exact moment when you learned the answer or do you not remember the exact moment when you learned the answer?

If remember: Can you tell me everything that you remember about the moment you learned the answer?

Follow-up questions:
How old were you?
Who was there?
Where were you?
What happened when you learned the answer?
What did you see and hear when this happened?

APPENDIX D

A diagram of the buildings children saw in experiment 2 are presented in appendix D.



The House
The Grocery Store
The School
1
2
3
4
5
6

APPENDIX E

The clues and narratives that were presented to the children in experiment 2 are presented in appendix E.

"The House"

Hidden object	4 Clues	Narrative
Basketball	1. You dribble it 2. It is round 3. It is usually orange 4. It is a type of ball	When I was a little girl, I went to the park (central).My friend came with me (central). We wanted to play basketball (central). But we couldn't because someone had locked up all 10 (peripheral) of the basketballs (object)
Dog	1. It barks 2. It has fur 3. It can walk on a leash 4. It drinks out of dish	When I was a little girl, I was in my basement by myself at night (central). When suddenly, I heard a loud noise (central). I turned to look (central). I heard barking, it was Sam (peripheral), my Dog (object).
Keys	1. You use them to open a lock 2. They go on a key ring 3. They can be made of metal 4. You need them to start a car	When I was a little girl, my dad drove me to school (Central). When we got there we both jumped out of the car (central) and locked the doors (central). But locked inside the car were my dad's silver (peripheral) keys (object)
Refrigerator	1. It keeps food cold 2. It has a door 3. It is usually in a kitchen 4. It usually has a freezer	When I was a little girl, my mom said I could buy a candy bar (central). It was really hot outside (central). So on the way home it melted in the car (central). When I got home, my mom put the candy bar inside our white (peripheral) refrigerator (object).
Doll	1. It is something you play with 2. It looks like a person, but it isn't real 3. It can be a boy or a girl 4. It is a toy	When I was a little girl, I went to a shopping mall (central) .I wanted to buy a toy (central). I looked until I found the perfect one (central). It had yellow hair (peripheral) and it was a little baby doll (object).
Couch/Sofa	1. You sit on it when you watch TV 2. It has cushions 3. It can be made of cloth or leather 4. It can have lots of pillows	When I was a little girl, I went to my friend's house (central). She had lost her toy (central). We looked all over her house (central) . We finally found it on her leather (peripheral) couch (object)

"The Grocery Store"

Picture of hidden object	4 clues	Narrative
Egg	1. It has a yellow yolk inside 2. You have to cook it to eat it 3. It is usually oval shaped 4. It is usually white	When I was a little girl, I decided to cook with my mom (central). I poured all of the ingredients into the bowl (central). Then I spilled something (Cental). I was trying to crack six (peripheral) eggs (object).
Milk	1. It is a white liquid 2. It is made on a farm 3. It comes from cows 4. You can drink it when you eat cookies	When I was a little girl, I was making breakfast for my dad (central). He wanted to eat cereal (central). So I poured the cereal in a bowl (central). But I spilled the ice cold (peripheral) milk (object).
Apple	1. They grow on trees 2. They are fruit 3. They can be red or green 4. They have seeds	When I was a little girl, I visited a farm (central). I wanted to pick some fruit (central) so I climbed up the ladder to one of the trees (central) and picked many green (peripheral) apples (object)
Popcorn	1. You eat it at the movies 2. It is made of corn 3. You can put butter on it 4. You can cook it in the microwave	When I was a little girl, I watched a movie with my family (central). We were all hungry (central). So, my brother made us a snack (central). He carried it out in a red bag (peripheral) and handed us the popcorn (object)
Bread	1. It has crust 2. It is made of flour 3. It can be white or wheat 4. You can make a sandwich with it	When I was a little girl, I had my friend over for lunch (central). We were both really hungry (central) and we wanted to make some sandwiches (central) Suddenly, I realized we couldn't because I had forgotten to buy the whole wheat (peripheral) bread (object.
Ice Cream	1. It is made with cream 2. It is frozen 3. You can eat it on a cone 4. You can put chocolate sauce on it	When I was a little girl, I went to the amusement park (central). I even ate lunch there (central). My mom said I could have desert (central) . So, I ordered a strawberry (peripheral) ice cream (object)

"The School"

Hidden Object	4 Clues	Narrative
Pencil	1. You write with it 2. It has an eraser on top 3. It has lead 4. You sharpen it.	When I was a little girl, I was working on my homework (central). Then my brother jumped up behind me (central). I leaped out of my chair (central) and I dropped my purple (peripheral) pencil(object).
Backpack	1. You use it to carry your books 2. It fits on your back 3. It has a zipper 4. It can be any color	When I was a little girl, I went hiking (central).My friend (central) came with me. We wanted to bring a picnic lunch with us (central). So we packed a lunch in our matching red (peripheral) backpacks (object).
Scissors	1. You hold them in your hand 2. You use them to cut paper 3. They are usually silver 4. They are usually sharp	When I was a little girl, I was working on an art project (central). I was cutting a piece of paper (central) and I wasn't watching where I was cutting (central). Suddenly I cut myself with the blue (peripheral) scissors (object).
Map	1. It shows countries and states 2. It is printed on a long piece of paper 3. It can give you directions if you are lost 4. It has a legend	When I was a little girl, I went on vacation (central). My family got lost on the way (central).So my dad had to look for directions(central). He used a yellow (peripheral) map (object).
Book	1. You read it 2. It has pages 3. It can have chapters 4. It can have pictures	When I was a little girl, I flew on an airplane (central). There was nothing to do on the plane (central). I couldn't see out the window (central). So, my mom read me a 25-paged (peripheral) book (object).
Blackboard	1. It is black 2. You write on it with chalk 3. It can hang on the wall 4. It is shaped like a rectangle	When I was a little girl, I wanted to be a teacher (central). One day my friends came over and I made them be my class (central) and I handed out worksheets (central). I even wrote on the miniature (peripheral) blackboard (object).

Appendix F

The letters documenting IRB approval are presented in appendix F. The studies were approved by the institutional review board at the University of New Hampshire.

University *of* New Hampshire

Research Conduct and Compliance Services, Office of Sponsored Research
Service Building, 51 College Road, Durham, NH 03824-3585
Fax: 603-862-3564

17-Apr-2007

Leichtman, Michelle D
Psychology, Conant Hall
Durham, NH 03824

IRB #: 3223
Study: How Middle Schoolers Use Memory During Examinations
Approval Expiration Date: 25-May-2006
Modification Approval Date: 09-Apr-2007
Modification: Changes to protocol per 4/6/07 email

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved your modification to this study, as indicated above. Further changes in your study must be submitted to the IRB for review and approval prior to implementation.

Approval for this protocol expires on the date indicated above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects in this study. If your study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, *Responsibilities of Directors of Research Studies Involving Human Subjects.* This document is available at http://www.unh.edu/osr/compliance/irb.html or from me.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Manager

cc: File
Bemis, Rhyannon

University *of* New Hampshire

Research Conduct and Compliance Services, Office of Sponsored Research
Service Building, 51 College Road, Durham, NH 03824-3585
Fax: 603-862-3564

06-Jun-2007

Leichtman, Michelle D
Psychology, Conant Hall
Durham, NH 03824

IRB #: 4008
Study: Gender Difference in Source Monitoring
Approval Date: 04-Jun-2007

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved the protocol for your study as Expedited as described in Title 45, Code of Federal Regulations (CFR), Part 46, Subsection 110.

Approval is granted to conduct your study as described in your protocol for one year from the approval date above. At the end of the approval period, you will be asked to submit a report with regard to the involvement of human subjects in this study. If your study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the attached document, *Responsibilities of Directors of Research Studies Involving Human Subjects.* (This document is also available at http://www.unh.edu/osr/compliance/irb.html.) Please read this document carefully before commencing your work involving human subjects.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Manager

cc: File
Bemis, Rhyannon